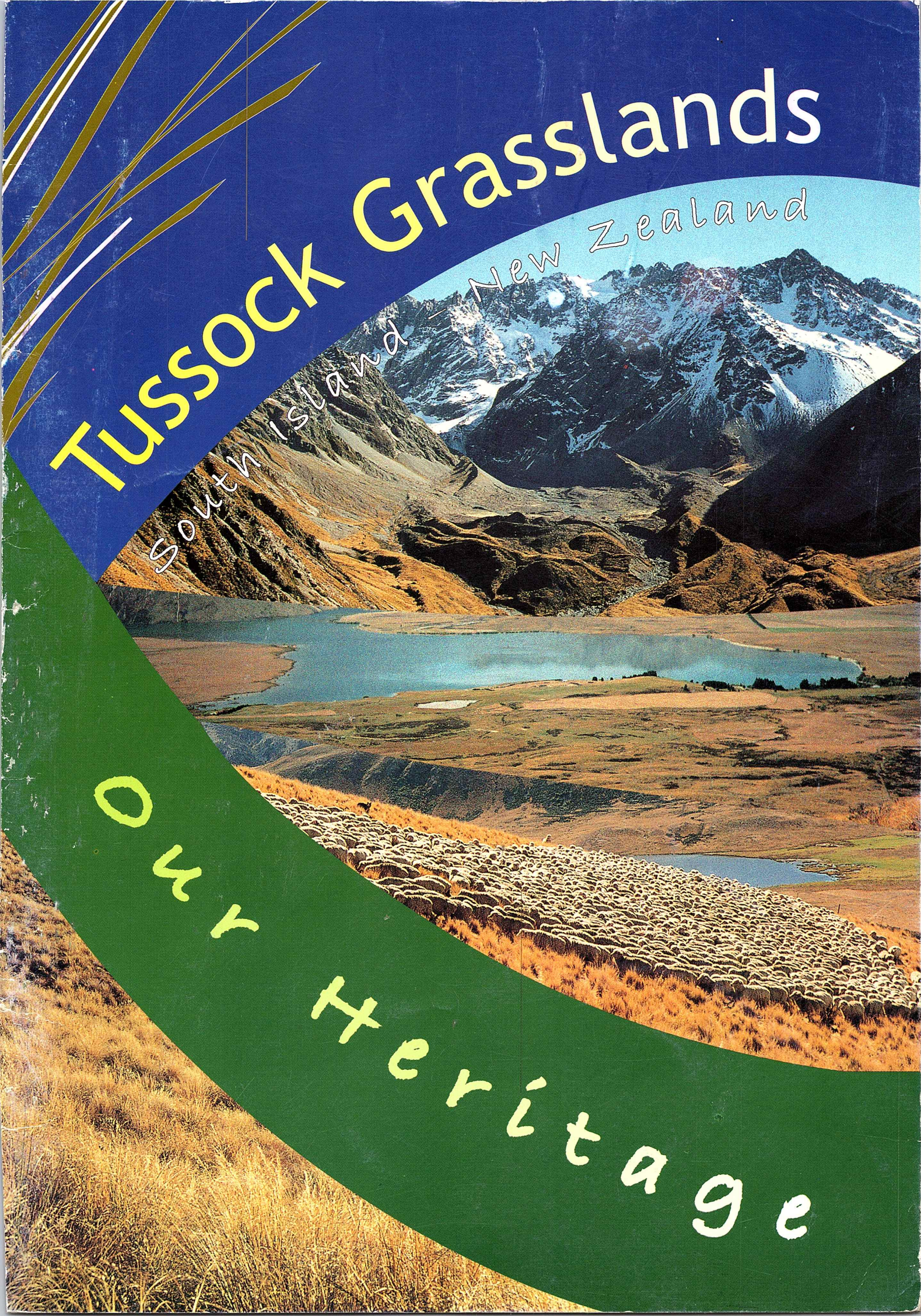
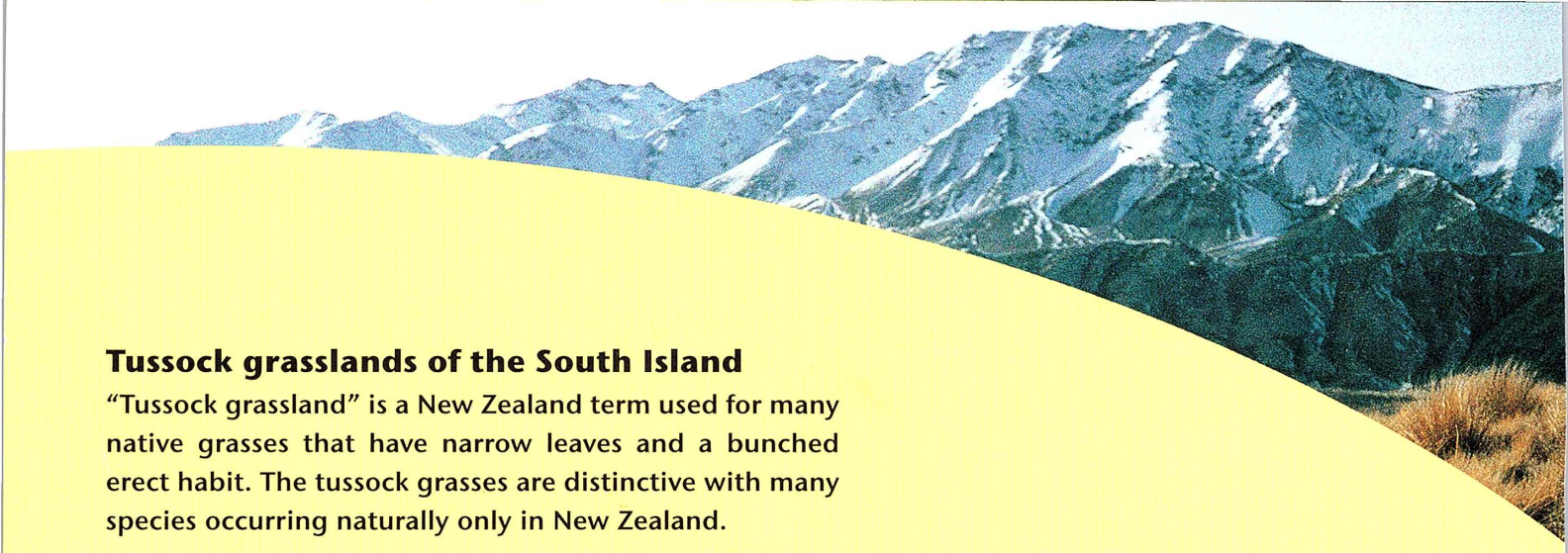
Tussock Grasslands

South Island – New Zealand



Our Heritage



Tussock grasslands of the South Island

"Tussock grassland" is a New Zealand term used for many native grasses that have narrow leaves and a bunched erect habit. The tussock grasses are distinctive with many species occurring naturally only in New Zealand.

Tenure of the 3.5 million ha of South Island tussock grasslands (as defined by NZ Land Cover Database) is varied, with

* about 45% of the land in pastoral leases
* 27% in Crown-owned conservation lands administered by the Department of Conservation under the National Parks, Reserves, and Conservation Acts
* the remaining 28% mostly freehold land in private ownership

Tussock grassland or extensively managed grassland – total: 3.5 million ha (excludes developed pasture)

Data sources: *NZ Land Cover Database (2000)*
Victoria Froude (2000)

Tussock Grasslands

South Island – New Zealand

Our Heritage

Compiled by C.M. Mulcock

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Introduction

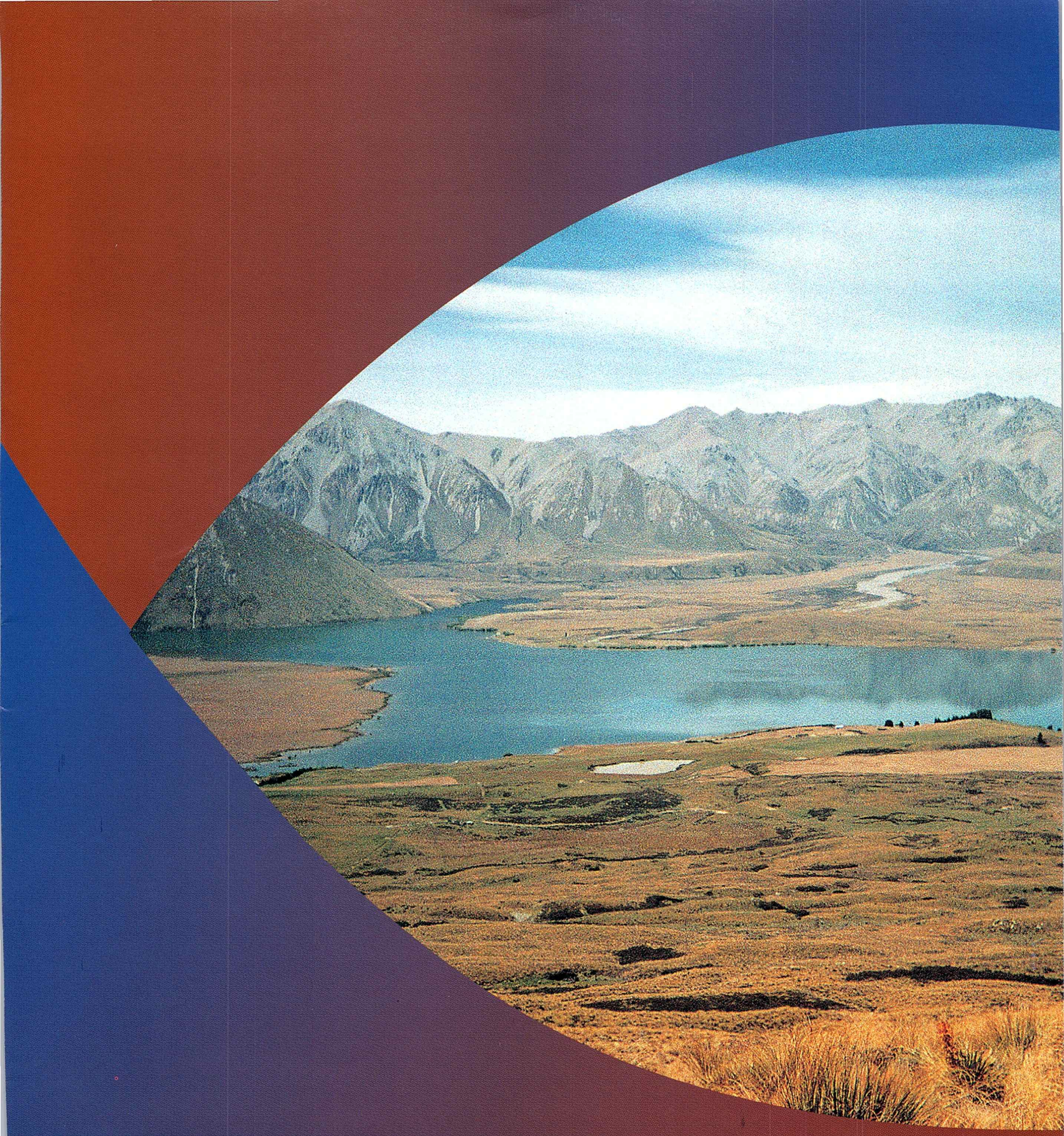
The South Island high country.

In the New Zealand psyche this vast, seemingly empty tract has come to represent our last frontier. It is a majestic place in which to live, work, play and experience a unique sense of wilderness.

The present landscape has been shaped by millions of years of natural events, and more recently by both Polynesians and Europeans. It is forever dynamic and will continue to change.

Many people have an affinity with the high country and mountain lands. The sense of involvement extends beyond those who live there. It means we all have a part to play in the future of the high country.

This booklet traces the history of the tussock grasslands to show how they have been shaped by past events. It reinforces the need to work together to ensure they have a healthy future.



Geological and ecological processes and human intervention shaped the tussock grasslands. If they were left alone, or if farming and forestry could be removed, they would not produce a landscape dominated by tall tussocks flowing in the wind ..... not even if we waited 50,000 years.

Tussock grasslands are complex, varied and dynamic ecosystems. They are subject to change brought about by natural processes, human disturbances and climate variations. These things will happen regardless of their ownership.

Their best long term management does not rely on a black and white choice between productive use or total conservation. Their future is in our hands. It requires understanding, an appreciation of diversity, and being able to value different approaches and uses.

This is a challenge demanding people with passion and a wide range of experience, knowledge and skills, as well as boldness for experimentation on large and small scales.

Tussock grasslands – our heritage

In 2001, the tussock grasslands have a vast range of near-natural to strongly modified habitats. We cannot return them to the state they were in 800 years ago, nor can we expect to preserve the present. Ecological change, driven by many natural factors, as well as human ones, means their evolution will continue. We must admit that even if left unmanaged, grasslands will continue to change. Introduced plants and animals, and climate impacts will ensure that. Active land management is essential in almost all areas, even for nature conservation.

For many years frustration has been building at the apparent impasse between differing views of how our tussock grassland heritage can be most effectively managed for the future. Despite a lot of time and energy being expended in meetings, hearings and so on, little has been achieved.

"I believe that the time has arrived where we all need to draw back from our cherished views and opinions, quit the posturing and confrontation, and sit down together and work towards land use decisions which the local and wider communities will come to accept and respect. But above all, let's do something positive now, and not just keep talking about it. "

Botanist, Dr Brian Molloy on"Conservation Values" 1994.

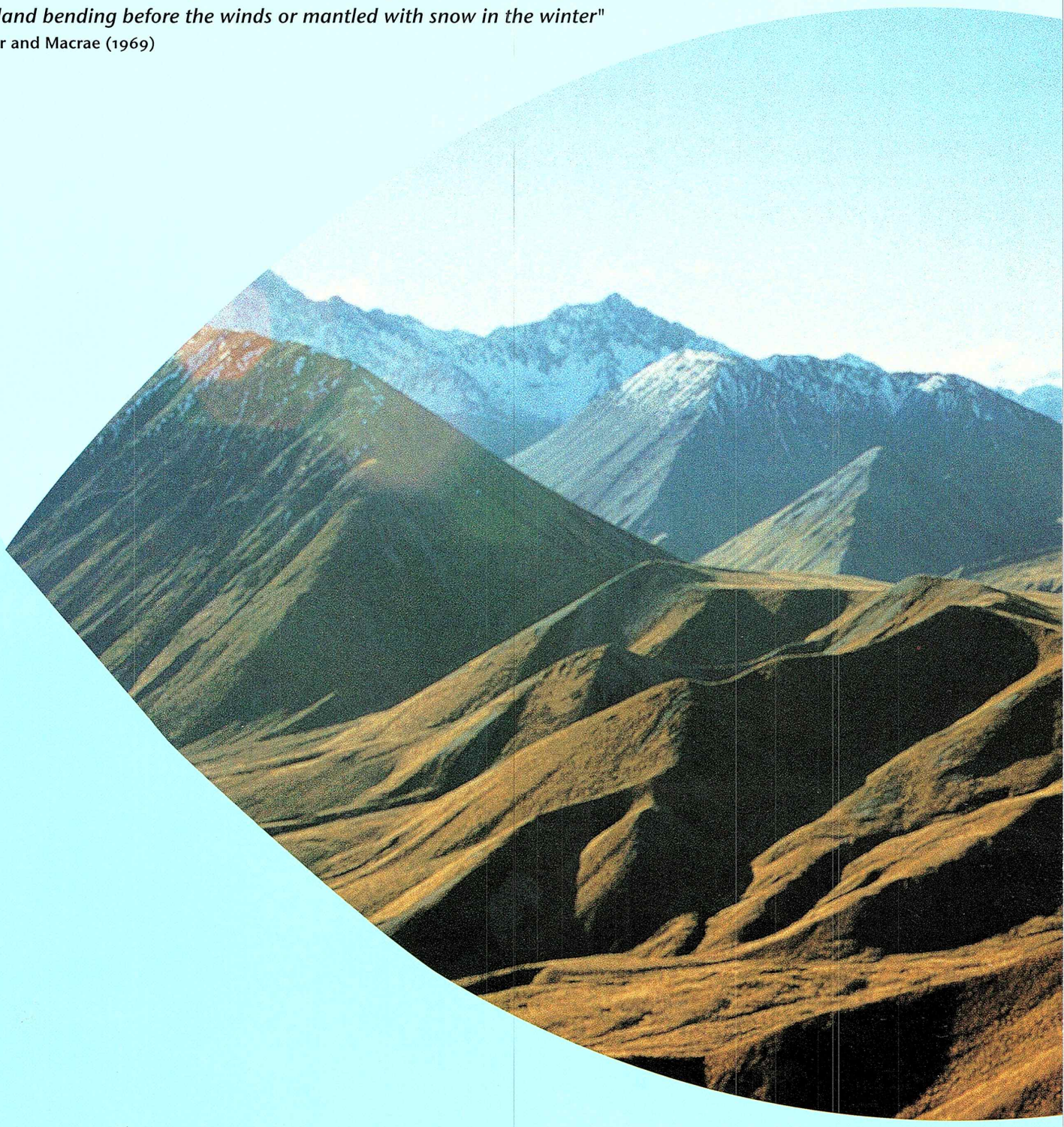
Right: Castle Hill, McCaskill reserve

Public Lands

Although the high country as a whole is well represented in Crown-owned conservation areas such as national parks and other reserves, tussock grasslands, especially those outside the high mountains and high rainfall zones, are not so well represented. In the South Island, the Department of Conservation manages 27% (0.94 million ha) of tussock grasslands, 55% (0.73 million ha) of alpine land and 86% (3.2 million ha) of indigenous forest. As pastoral lease tenure is reviewed, further areas are being included in the Crown-owned conservation lands, again mostly from higher altitudes. These public lands are retained primarily for nature conservation, although they also meet other objectives (e.g. scientific, recreational, landscape). It is increasingly apparent that privately owned land can also meet such objectives.

Data source: Froude (2000)

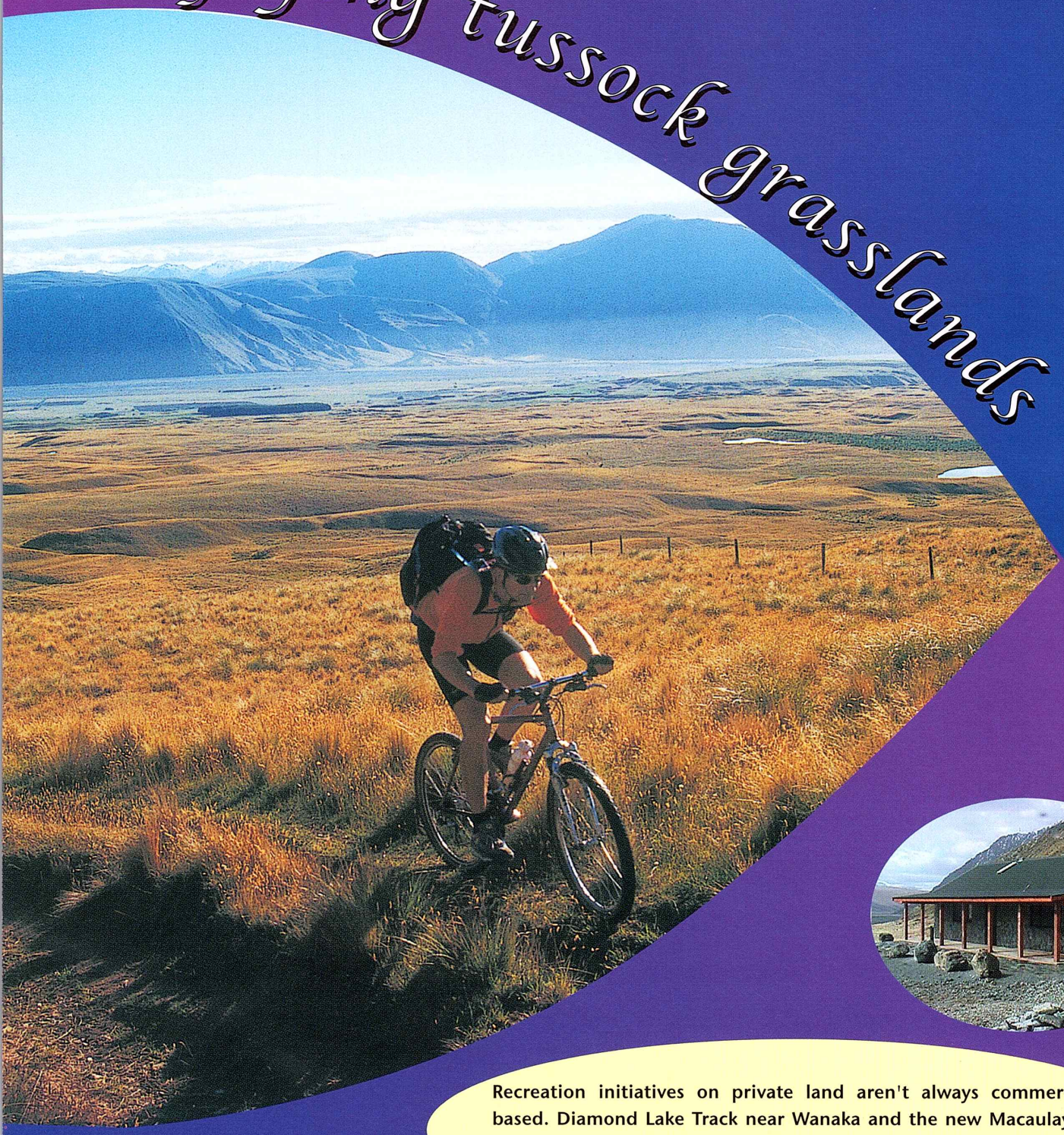
"The tussock country; the back country; the high country – evocative words all of them, recalling vast acres of shining yellow to dulled green grassland bending before the winds or mantled with snow in the winter"
Connor and Macrae (1969)



Opportunities for Integrated Uses

A blend of land uses can improve the diversity, interest and quality of a landscape, without loss of integrity. Integrating specific nature conservation objectives into a farm property can promote ecological soundness, with many benefits. For example, forest or shrubland remnants needing strict management for nature conservation, can often be best protected from fire or conifer invasion within a managed pastoral landscape. Healthy tussock grasslands are an ideal backdrop for commercial recreation or tourism enterprises combined with commercial livestock farming. Income from more profitable uses can help meet management costs of others, including conservation. New Zealanders and overseas visitors increasingly seek, and are prepared to pay for, holidays in secluded, beautiful environments, with good accommodation facilities and a range of outdoor activities.

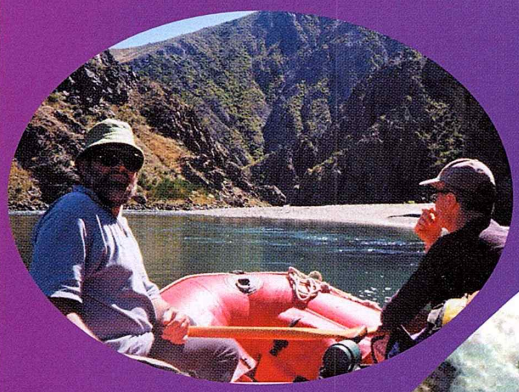
Enjoying tussock grasslands

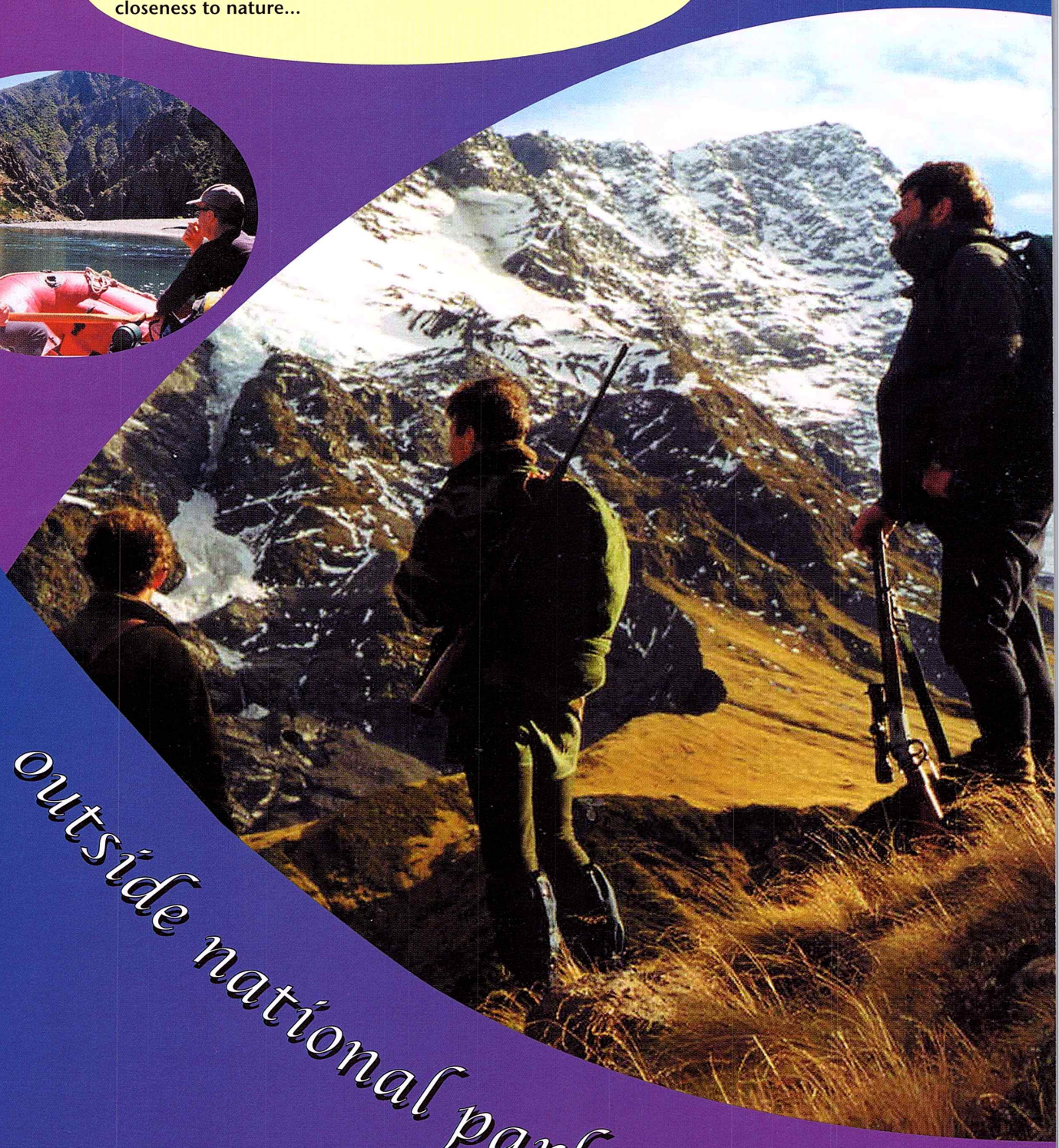


Recreation initiatives on private land aren't always commercially based. Diamond Lake Track near Wanaka and the new Macaulay hut near Tekapo are two examples of public spirited developments by a farming family and a group of local people.

Farm-based commercial enterprises offering options such as 4WD tours, back country fishing, mountain biking and different types of accommodation provide opportunities for a wide range of people by offering a greater selection of services than can be provided on public lands alone.

People seek a range of experiences in the outdoors – challenge, fitness, solitude, sociability, spiritual development and renewal, closeness to nature...





outside national parks & reserves

Diversity in land ownership increases the range of opportunities for recreation and tourism and has the potential to help protect the natural environment. To ensure that recreation or tourism experiences are positive, farms need to be managed to meet all the objectives.

Areas with significant natural values are not confined to the Crown-owned conservation areas. Recreation on private land is widespread. Runholders have traditionally hosted and supported recreational visitors, and are keen to continue this role, as well as to maintain customary access through farms to public lands beyond.

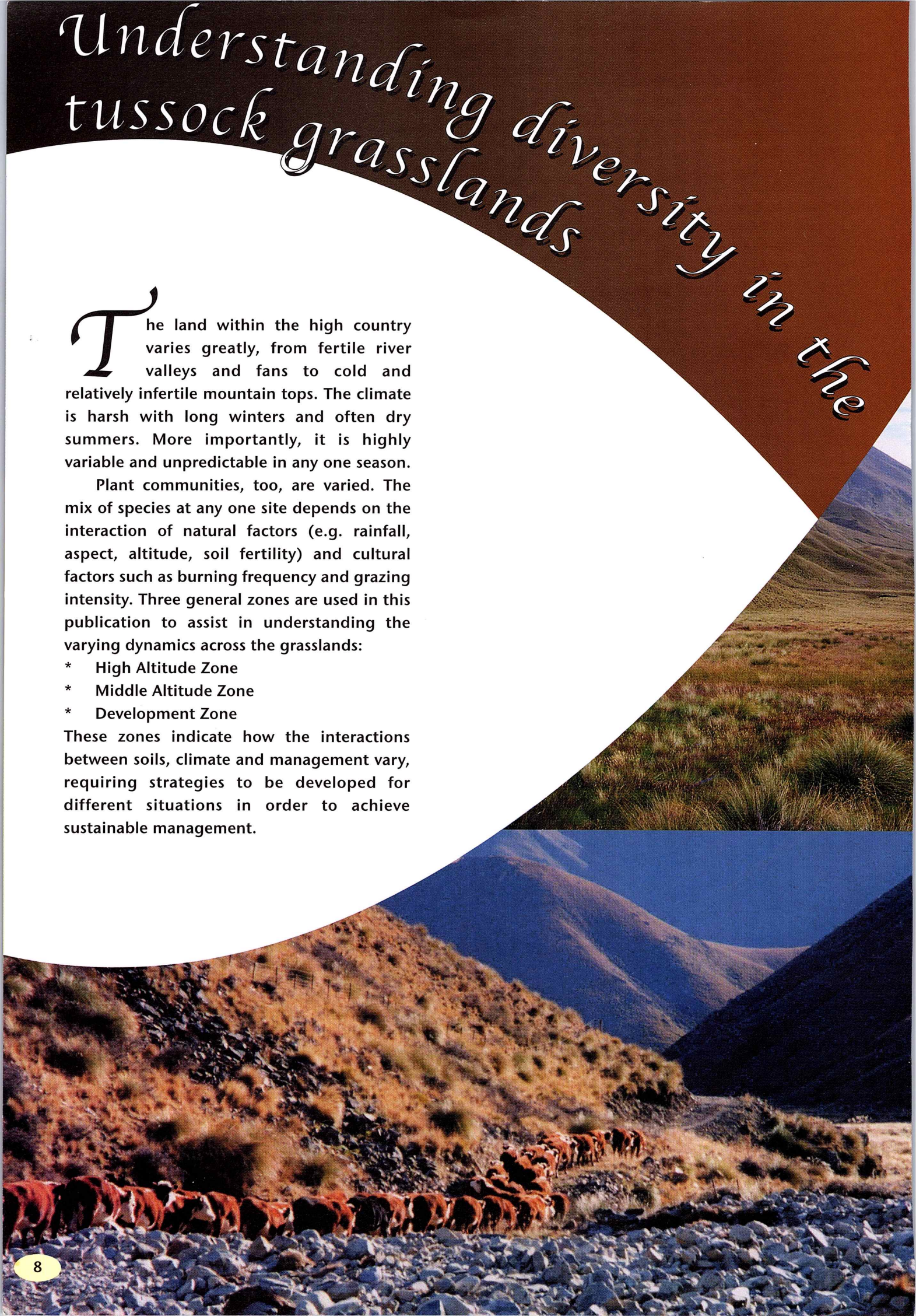
Understanding diversity in the tussock grasslands

The land within the high country varies greatly, from fertile river valleys and fans to cold and relatively infertile mountain tops. The climate is harsh with long winters and often dry summers. More importantly, it is highly variable and unpredictable in any one season.

Plant communities, too, are varied. The mix of species at any one site depends on the interaction of natural factors (e.g. rainfall, aspect, altitude, soil fertility) and cultural factors such as burning frequency and grazing intensity. Three general zones are used in this publication to assist in understanding the varying dynamics across the grasslands:

* High Altitude Zone
* Middle Altitude Zone
* Development Zone

These zones indicate how the interactions between soils, climate and management vary, requiring strategies to be developed for different situations in order to achieve sustainable management.



High Altitude Zone

This zone is above the natural treeline, which varies from 900 metres in the south to more than 1200 m further north. Here native plant communities of grasses, herbs and dwarf shrubs are relatively stable with few introduced species. Current uses are conservation, recreation, and in some areas, limited late summer grazing. Much of this land is in Crown ownership, under Department of Conservation management. The grassland flora and fauna here have evolved more naturally than elsewhere in the NZ mountains. Because of this, conservation of large areas is especially important.

Middle Altitude Zone

These grasslands are ecologically less stable than those at higher altitudes, both because they developed from forest in Polynesian times and because tall tussock grasslands were partly converted to short grasslands during early pastoralism. Being derived from forest they have a natural tendency for woody species to take over where land is not actively managed to retain native and introduced grassland species. Continued seasonal use for grazing at low stocking levels is important for most pastoral businesses. Pasture development is much less evident close to the treeline than at lower altitudes, but this zone has many management and use options, including opportunities to integrate recreation, conservation and pastoral production.

Development Zone

In this zone, which is centred on but not confined to the easy terrain on terraces, fans and downlands, pasture has already been developed to various degrees wherever soils and climate are suitable. Very few large areas remain that are representative of vegetation types from pre-European settlement. Small remnants of native wooded vegetation in gullies, and some wetland communities in undrained lowlands still present opportunities for nature conservation where they can be insulated against disturbance caused by activities in adjacent farm land.

High altitude grasslands above treeline

This zone is above the native treeline (the natural upper limit of indigenous tree growth). The natural plant communities here have a much longer evolution than grasslands at lower altitudes and in many ways are ecologically more stable.

These higher areas are cooler, with moist soils and most plants grow slowly. The natural plant communities consist of snow tussocks in association with herbs, dwarf shrubs, cushion plants and alpine grasses.

Little of this country has ever been oversown or topdressed. However, in some areas it was heavily stocked during early pastoral history as the lower country deteriorated and stock moved higher in search of feed. Now it is well understood that the amount of grazing available at this altitude is limited, and fences ensure good stock control. If accidental fires occur recovery can be good, especially with managed control of grazing.

The high altitude zone has many sites with high erosion potential because of slope steepness, active earthquakes and sometimes high levels of rainfall. Natural erosion processes of frost, wind and water have been at work in the high altitude zone for centuries, producing some striking features such as shingle slides and screes. For some years it was wrongly believed that grazing and burning had created or accelerated this erosion.

above the treeline

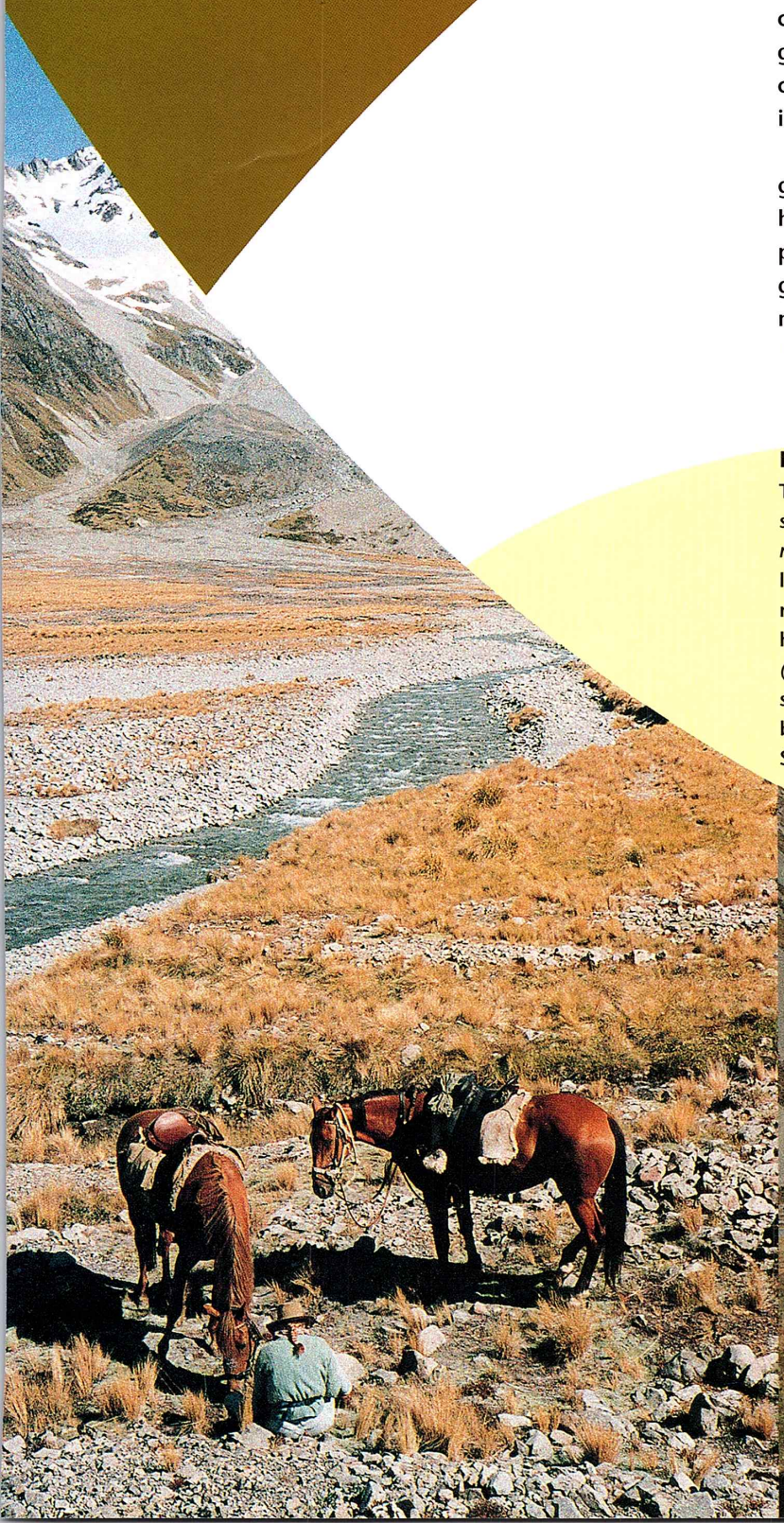
Introduced plants, especially sorrel and hieracium are found, but up to now have rarely dominated patterns of indigenous plants. Known pest and weed problems, including rabbits, are not major threats, except for hieracium in some areas.

The future for these grasslands is primarily for nature conservation, recreation and tourism with low intensity grazing in some areas. On many properties high altitude country provides a necessary strategic reserve of feed that is used sparingly to benefit lower country.

The need for active management to retain a grassland ecology will generally be limited, except for hieracium problems. In tenure reviews of land under pastoral lease, significant areas of high altitude grasslands are being retained in Crown ownership to be managed for conservation.

Native plants of the high altitude grasslands:

The high altitude grasslands are dominated by snow grasses or snow tussocks especially *Chionochloa* species. *Chionochloa rigida* (narrow leaved snow tussock), *Ch. flavescens* (broad-leaved snow tussock), *Ch. macra* (tussock) and *Ch. pallens* (mid-ribbed snow tussock) are common. Other native grasses and herbs above the treeline include various mountain daisies *(Celmisia* spp.*)*, eyebrights *(Ourisia* spp.*)*, spaniards *(Aciphylla* spp.*)*, buttercups *(Ranunculus* spp.*)*, gentians *(Gentiana* spp.*)*, blue tussock *(Poa colensoi)* and several fescues *(Festuca* spp.*)*. Shrubs include *Leucopogon colensoi* (mountain heath), *Gaultheria depressa* (snow berry), *Pimelea* spp. (native daphnes), and *Hebe* spp. (koromikos).



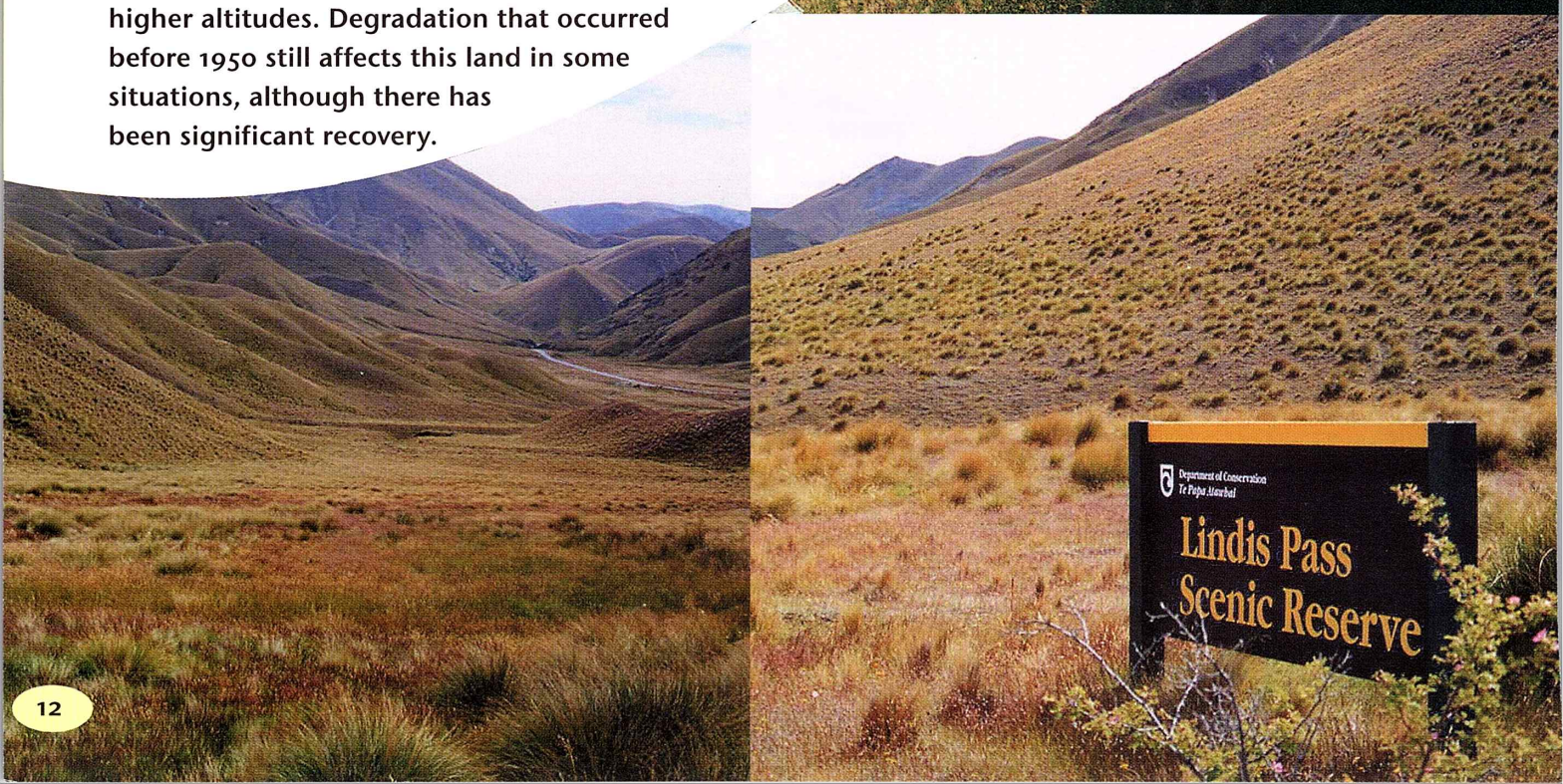
Middle altitude zone below treeline

The native tree line is the upper limit of the middle altitude grassland zone. The steep landscapes that visitors see close-up as they travel over Porters Pass, Lindis Pass or the Crown Range are typical. As in the high altitude grasslands, climate limits production with a fairly short growing season.

This zone was once forest but tall-tussock grasslands and shrublands developed following repeated fires lit by Polynesian moa hunters. After frequent burning and grazing by early pastoralists, many of the tall tussock grasslands were further modified to short tussock grasslands. Woody plants remained a problem.

For many years pastoralists used burning and grazing to prevent grasslands reverting to scrub or dense, tall tussock. Since the 1950s management options have increased. In some areas oversowing and topdressing are viable, especially with sufficient subdivision by fencing to ensure good grazing control. Most of this zone cannot yet be developed economically, but it still provides an important component of summer feed on many properties, especially in dry years.

Management today is very different from the past. Increased pasture development and use of fertilisers especially on flats and fans at lower altitudes, have greatly reduced grazing pressure at higher altitudes. Degradation that occurred before 1950 still affects this land in some situations, although there has been significant recovery.



below treeline

In this zone future options will vary because of differences in climate, soil, scenery, and economic opportunity. Pastoral farming, nature conservation, commercial tourism and public recreation each have a place. Native and introduced woody plants are an ongoing problem wherever maintaining grasslands is important, whether for pastoral farming, landscape qualities or some nature conservation purposes.

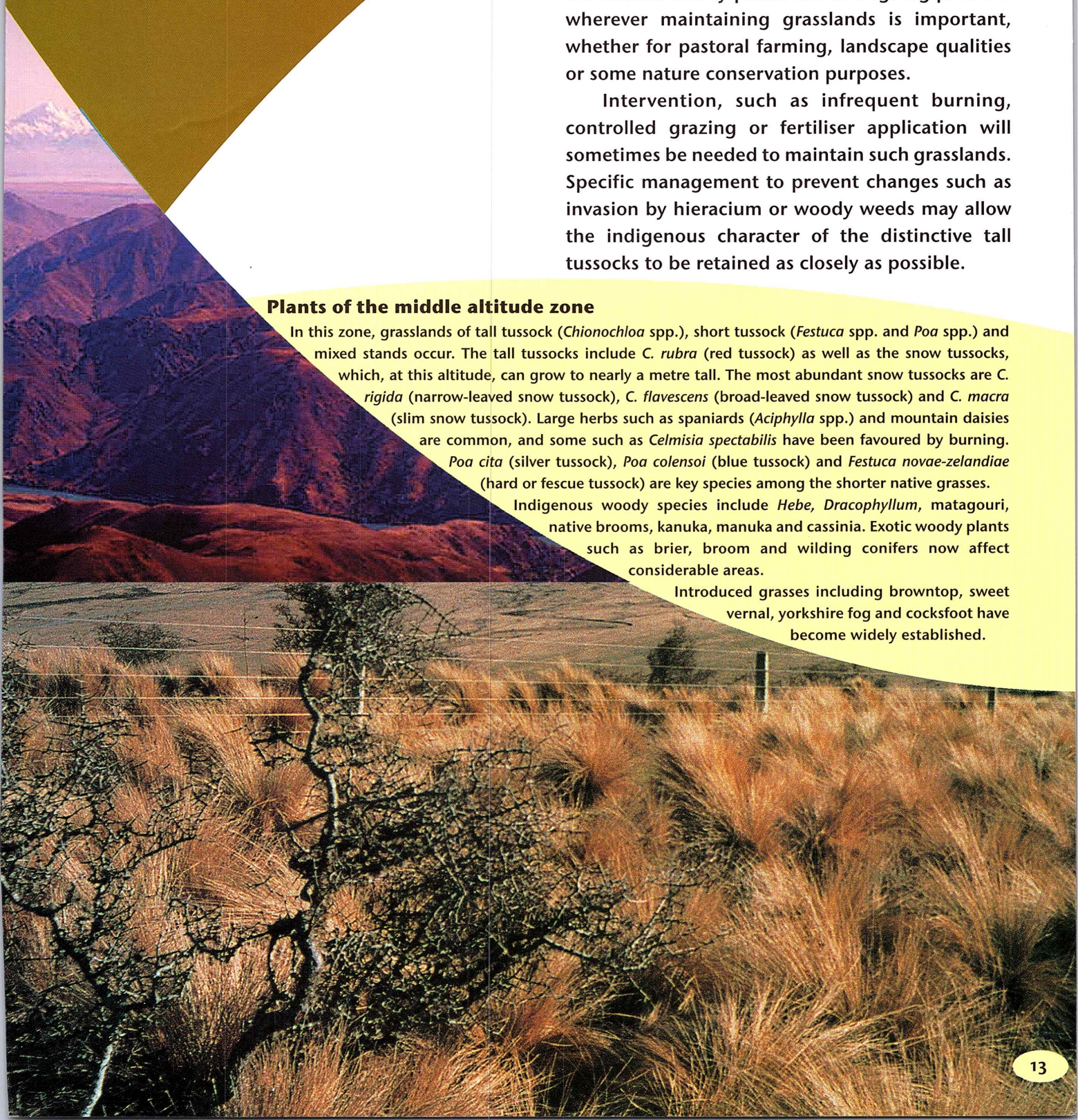
Intervention, such as infrequent burning, controlled grazing or fertiliser application will sometimes be needed to maintain such grasslands. Specific management to prevent changes such as invasion by hieracium or woody weeds may allow the indigenous character of the distinctive tall tussocks to be retained as closely as possible.

Plants of the middle altitude zone

In this zone, grasslands of tall tussock (*Chionochloa* spp.), short tussock (*Festuca* spp. and *Poa* spp.) and mixed stands occur. The tall tussocks include *C. rubra* (red tussock) as well as the snow tussocks, which, at this altitude, can grow to nearly a metre tall. The most abundant snow tussocks are *C. rigida* (narrow-leaved snow tussock), *C. flavescens* (broad-leaved snow tussock) and *C. macra* (slim snow tussock). Large herbs such as spaniards (*Aciphylla* spp.) and mountain daisies are common, and some such as *Celmisia spectabilis* have been favoured by burning. *Poa cita* (silver tussock), *Poa colensoi* (blue tussock) and *Festuca novae-zelandiae* (hard or fescue tussock) are key species among the shorter native grasses.

Indigenous woody species include *Hebe, Dracophyllum*, matagouri, native brooms, kanuka, manuka and cassinia. Exotic woody plants such as brier, broom and wilding conifers now affect considerable areas.

Introduced grasses including browntop, sweet vernal, yorkshire fog and cocksfoot have become widely established.

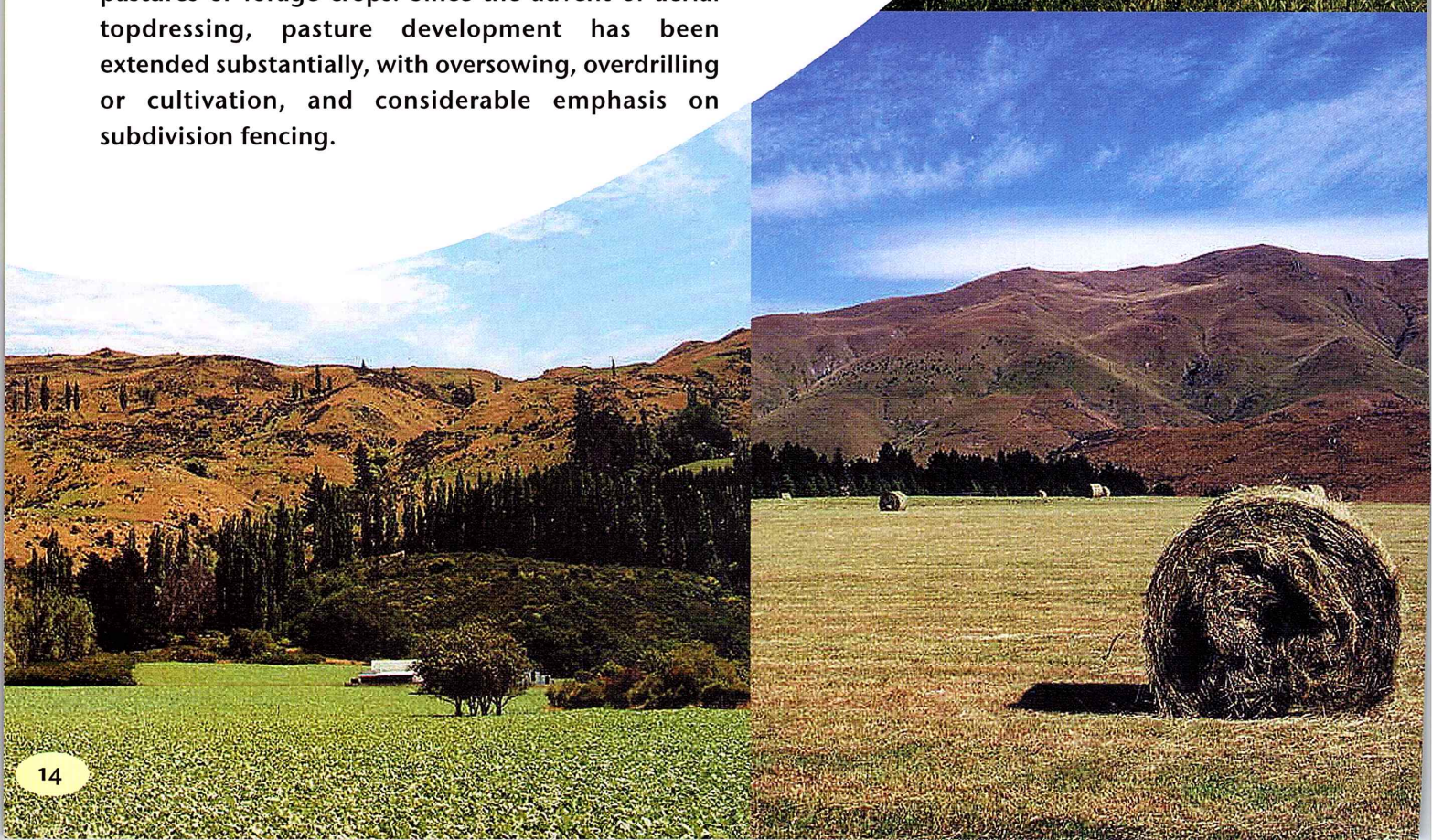


Development zone

The development zone is lower altitude, generally flatter country. There is no distinct altitudinal boundary with the middle altitude zone, although in most areas there is limited development above 1000 m.

Apart from river flats and wetlands, this land was largely in forest and scrub in pre-Polynesian times. When Europeans arrived, a great proportion of this zone was in tall tussock, except in drier areas where short grasslands occurred. Tall tussock grasslands, which had been kept from reverting to scrub or forest by repeated fires, were further transformed by burning and grazing to short grasslands. In drier situations, these grasslands were depleted and become weed communities. These dry lands were also preferred rabbit habitat. When rabbit populations increased further degradation occurred leaving unpalatable woody and mat vegetation, hieracium and tussock remnants.

Early settlers grew oat crops to feed horses, but initially they relied entirely on native grasslands as pasturage for sheep and cattle. Over time, better soils have often been developed into cultivated pastures or forage crops. Since the advent of aerial topdressing, pasture development has been extended substantially, with oversowing, overdrilling or cultivation, and considerable emphasis on subdivision fencing.



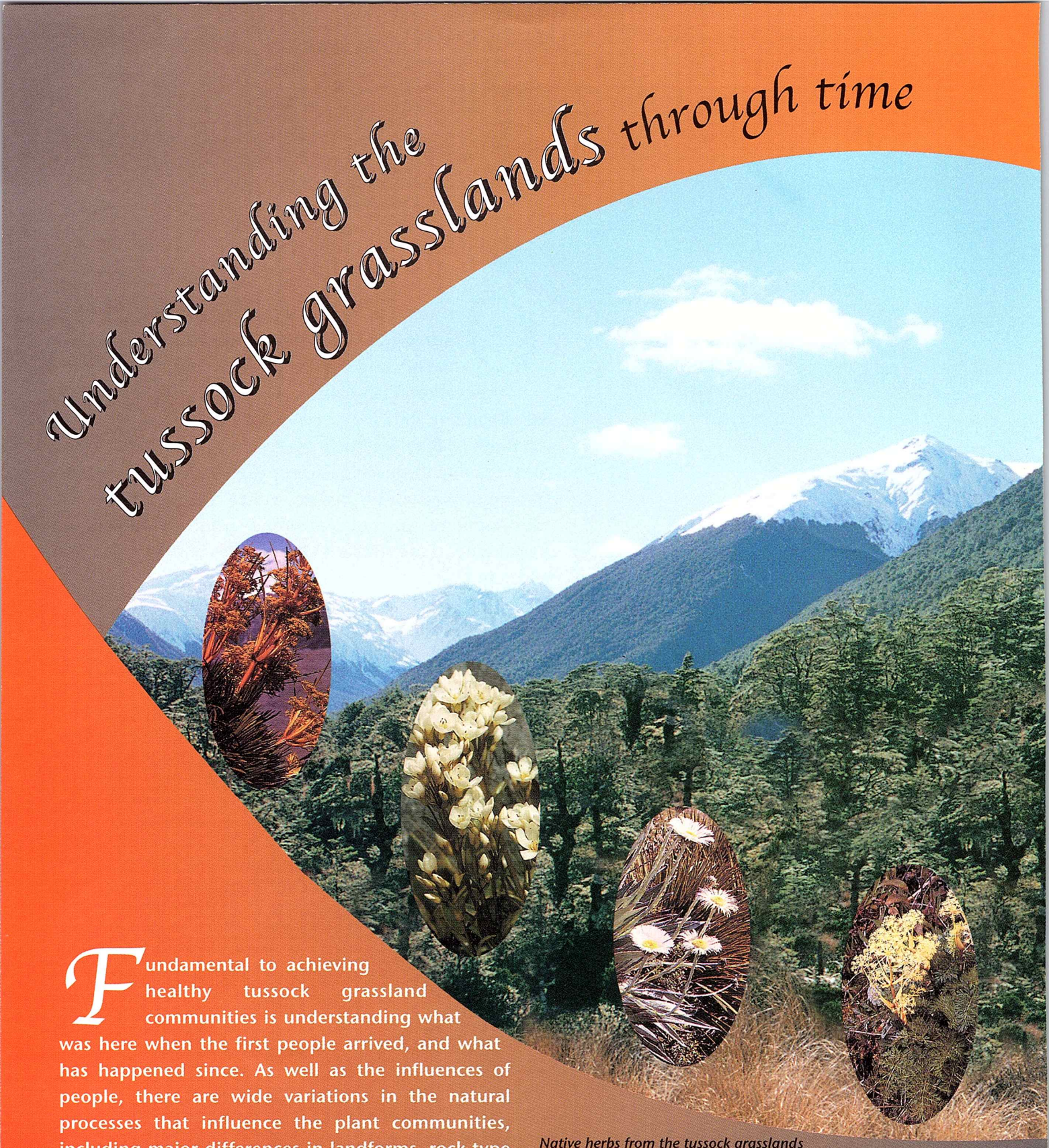
On suitable sites diversification from pastoral farming is increasing. Farm-scale plantation forestry and vineyards are two popular options.

There are still large areas of undeveloped land in this development zone – especially flats with shallow, stony or poor fertility soils with very low rainfall, which are uneconomic to develop, except perhaps with irrigation. Where lower country is dark, steep, and unsuitable for development, current ecology and management requirements are similar to that for the middle altitude zone.

Lower altitude plants

Following fire, red tussock *(Chionochloa rubra)* spread from enclaves in forest clearings, and short grasses, growing to 50 cm tall, spread from river beds and drier areas and later from tall tussock grasslands. Key species are the silver *(Poa cita)* and hard or fescue tussocks *(Festuca novae-zelandiae)*. Blue tussock *(Poa colensoi)*, the New Zealand wheatgrasses *(Elymus* spp.*)* and danthonia or bristle tussock *(Rytidosperma* spp.*)* were also common. Native species found amongst the short tussocks include matagouri, native brooms *(Carmichaelia* spp.*)*, speargrasses *(Aciphylla* spp.*)*, and native daphnes *(Pimelea* spp.*)*. In this zone there are now limited areas where tussock grassland species dominate but important wetlands do remain. Introduced species include grasses (cocksfoot, yorkshire fog, red and chewings fescue, browntop, sweet vernal); legumes such as clovers; and woody species including brier, wilding conifers, gorse and broom.

Understanding the tussock grasslands through time



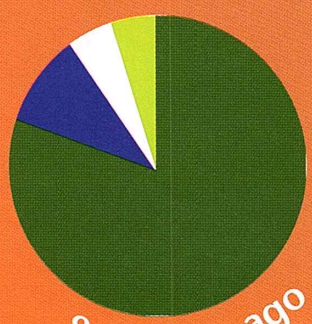
Fundamental to achieving healthy tussock grassland communities is understanding what was here when the first people arrived, and what has happened since. As well as the influences of people, there are wide variations in the natural processes that influence the plant communities, including major differences in landforms, rock type and rainfall.

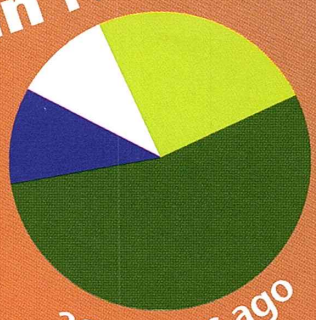
Today there are about 3.5 million hectares in the South Island where short and tall tussocks are the most abundant plant cover, interspersed with other indigenous and exotic plants. Before human intervention there were only about 1.5 million hectares of tussock lands. After the Polynesian fires the area increased to about 8 million hectares. Tussock grasslands today cover about half of the South Island high country; the rest is mainly forest, shingle scree, snow and ice.

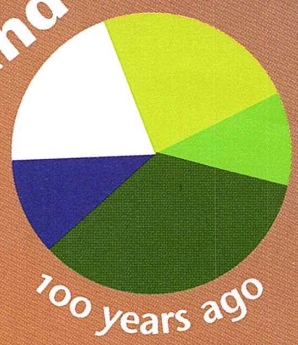
Native herbs from the tussock grasslands (left to right)
** Aciphylla montana (spaniard)*
** Gentiana corymbifera (snow gentian)*
** Celmisia semicordata (mountain daisy)*
** Anisotome haastii (Haast's carrot)*

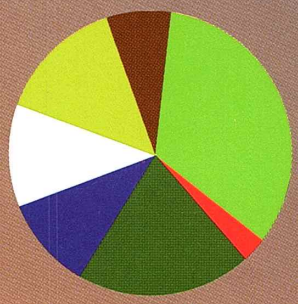
The story of how large areas of tussock grasslands evolved from forest through human intervention, and have since been altered significantly is fascinating but not well known. We tell it here because understanding both the natural and cultural ecological changes over time is important for future management.

Land Cover in New Zealand







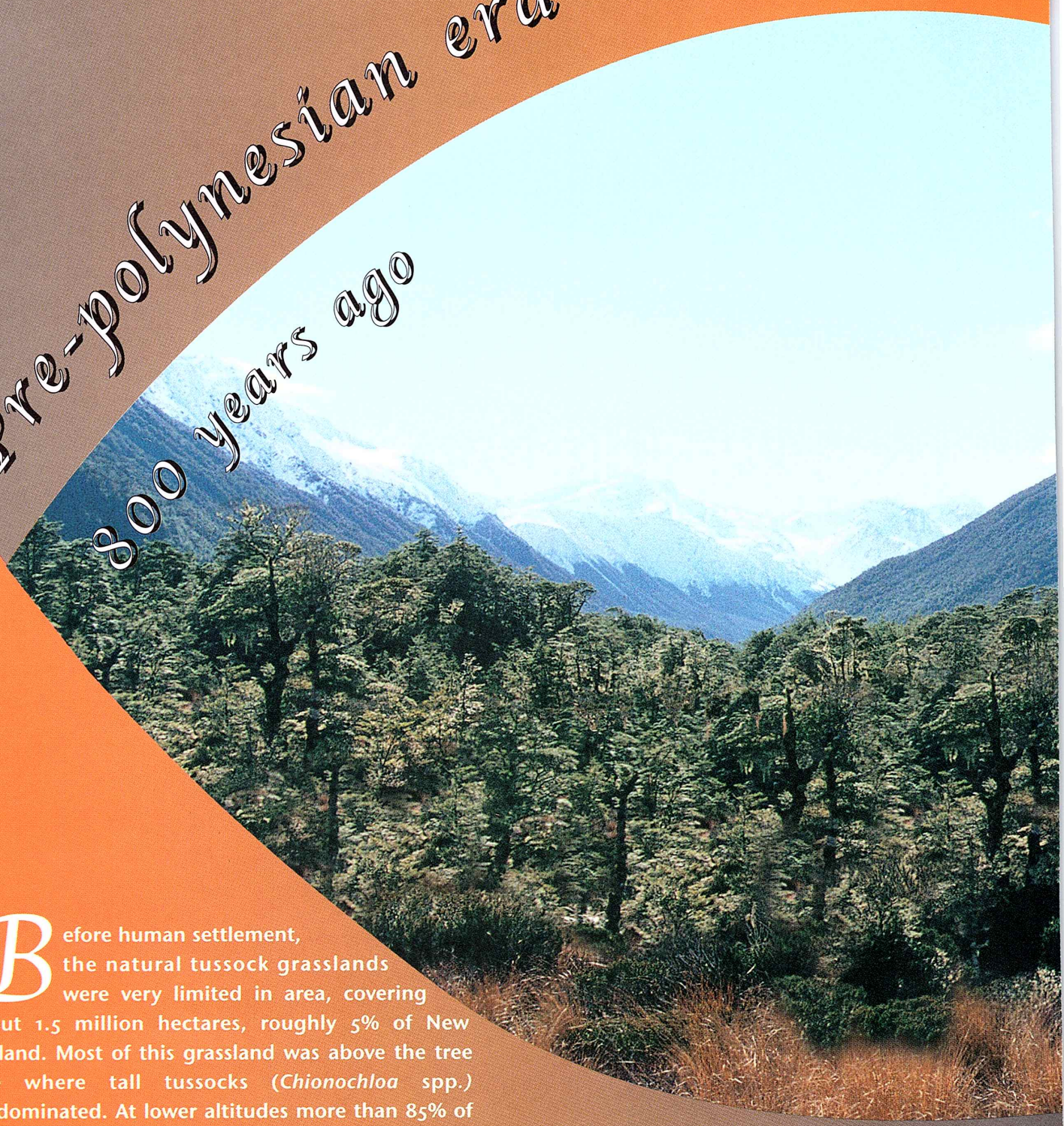


- Alpine
- Tussock grassland
- Exotic grassland
- Scrub, wetland
- Native forest
- Exotic forest
- Settlements, crop

Data source: "The State of New Zealand's Environment 1997"

Pre-polynesian era

800 years ago

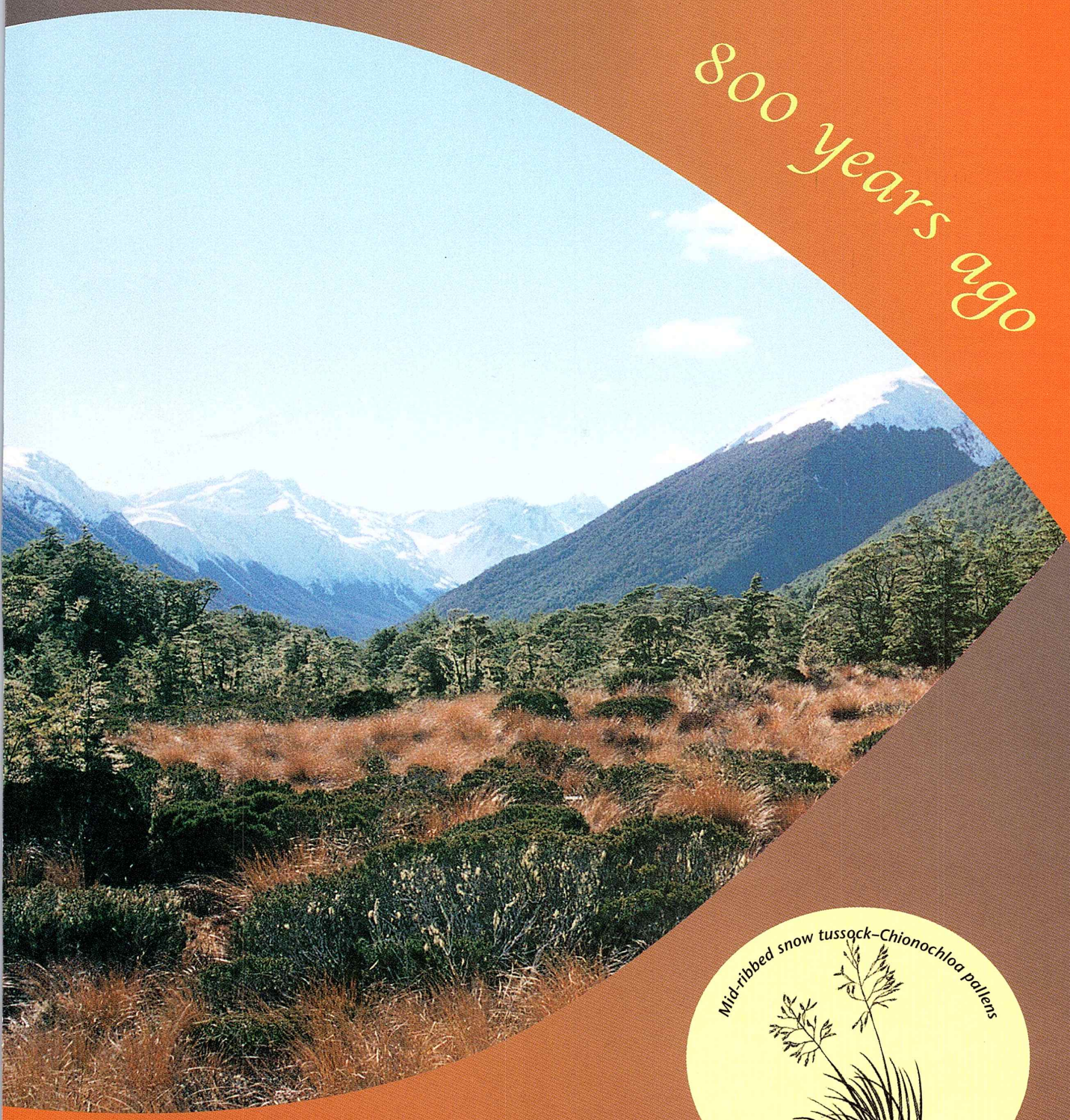


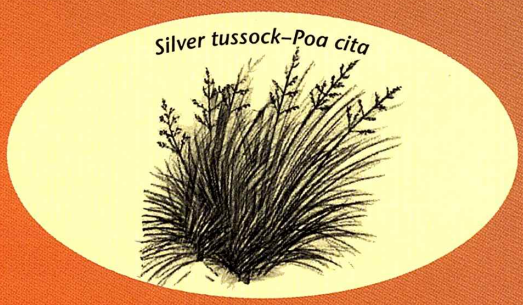
Before human settlement, the natural tussock grasslands were very limited in area, covering about 1.5 million hectares, roughly 5% of New Zealand. Most of this grassland was above the tree line where tall tussocks (*Chionochloa* spp.) predominated. At lower altitudes more than 85% of the country, including the South Island, was forested. On the drier eastern side of the Main Divide of the South Island, most of the forests were dominated by either beeches (*Nothofagus* spp.) or native conifers such as totara or matai. Patches of tussock grasslands occurred within the forests. Red tussock (*Chinochloa rubra*) grew where poor drainage inhibited tree growth. Short tussocks (principally *Festuca* or *Poa* spp.) grew initially where landslides, windthrow or lightning strike had temporarily cleared the forest.

In drier seasons in low rainfall areas, such as Central Otago, fire caused by lightning strike seems to have periodically destroyed large areas of forest or scrub. Grasslands colonised these burnt out areas, but over centuries, regenerating forest would have invaded again, so long as fire did not recur.

Unlike grasslands in most parts of the world, these grasslands, whether tall tussock or other shorter species, were developed in the absence of grazing mammals.

800 years ago



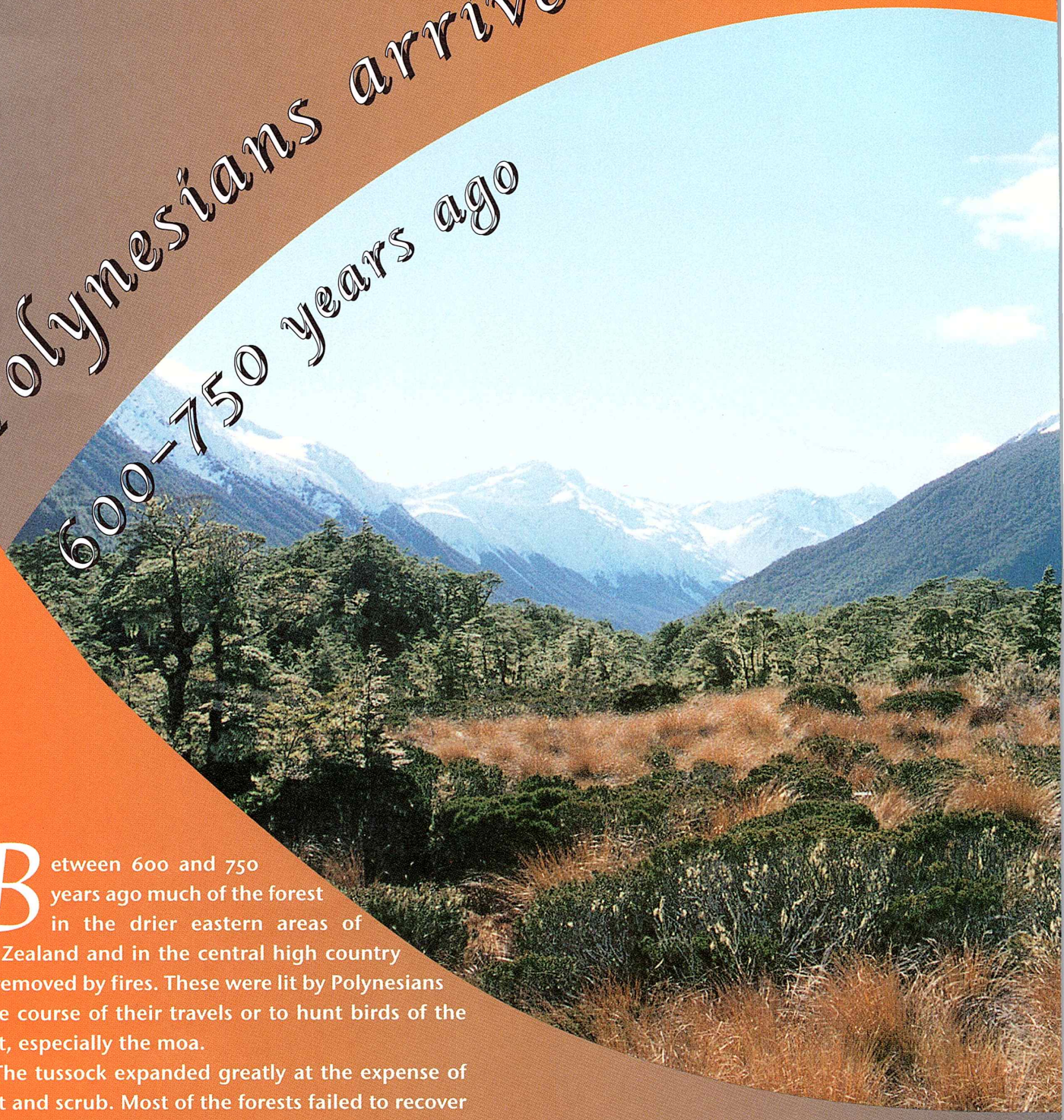


Before people intervened, short tussocks occurred only in small patches where the forest didn't grow.

The natural habitat for tall tussocks and a wide range of alpine plants and insects of high ecological value is above the treeline. These indigenous species only spread to lower altitudes as the forest was removed.

Polynesians arrive

600–750 years ago



Between 600 and 750 years ago much of the forest in the drier eastern areas of New Zealand and in the central high country was removed by fires. These were lit by Polynesians in the course of their travels or to hunt birds of the forest, especially the moa.

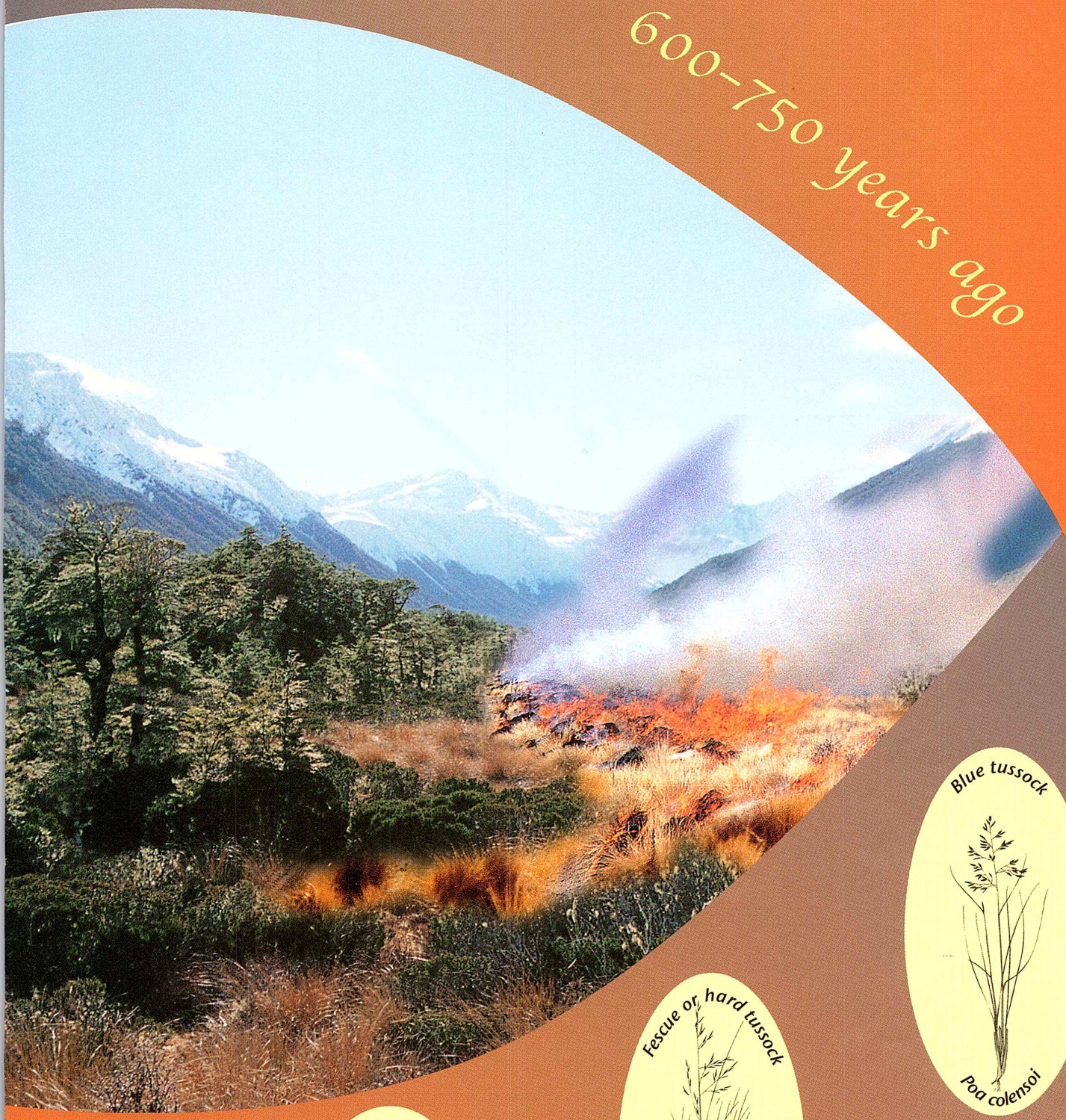
The tussock expanded greatly at the expense of forest and scrub. Most of the forests failed to recover because of repeated fires, and the naturally slow regeneration of beech forest.

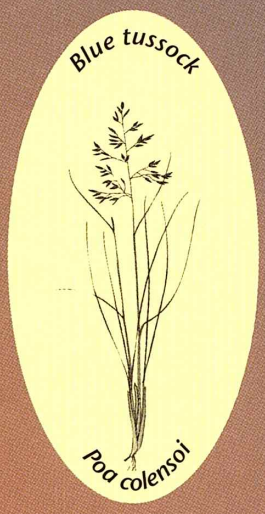
Most of area burnt was occupied by bracken, shrubland and grassland. In the area we now call the high country, tall tussock grasslands (*Chionochloa* spp.) became widespread downslope from their natural environment in the high mountain zone. Short tussocks (*Festuca, Poa* spp.) and other grasses moved upslope from riverbeds and other disturbed sites. Red tussock (*Chionochloa rubra*) spread widely at lower altitudes from its niche in wetter soils within the forests.

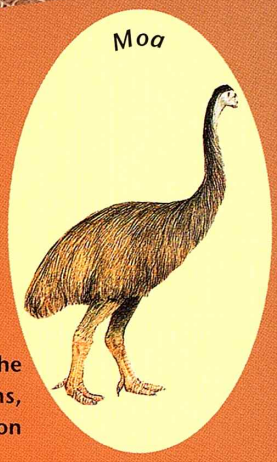
Most of the tussocks below the treeline are colonisers that took advantage of forest fires lit by humans. Were it not for the recurrent lighting of fires by humans over the last 750 years, recovery of scrub or forest would have occurred everywhere except for the driest parts of Central Otago.

By the time Europeans arrived the area of tussock grasslands in the South Island had increased about five fold; from about 1.5 million hectares to about 8 million hectares.

600–750 years ago



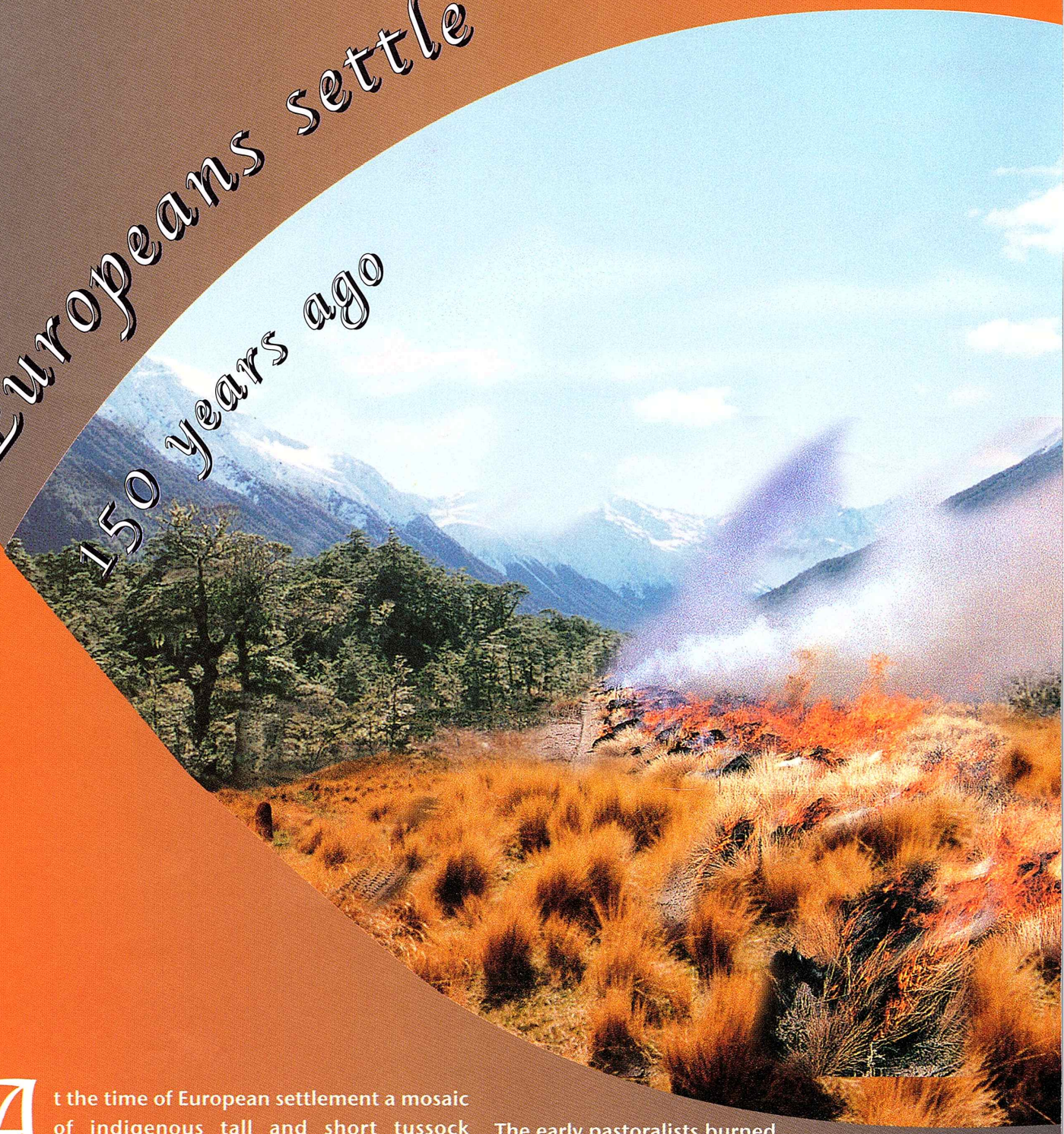




Moa were primarily birds of the forest and forest margins, browsing like deer and goats on seeds, leaves, twigs and fruit.

Short tussocks, such as these, as well as bracken and shrubs occupied areas where the forest was burnt. The grasslands expanded as burning became more frequent.

Europeans settle 150 years ago

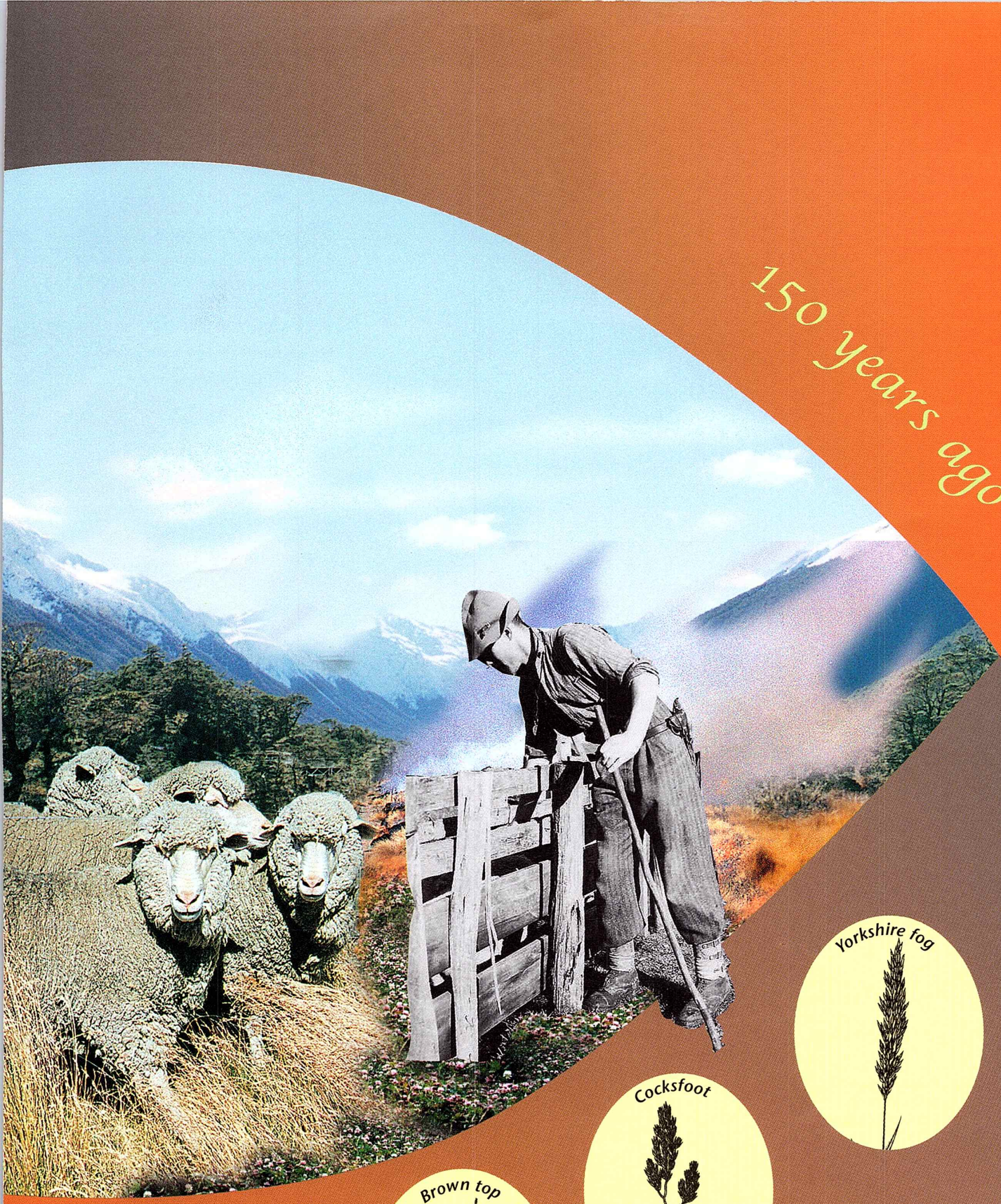


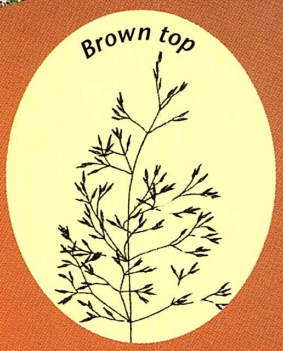
At the time of European settlement a mosaic of indigenous tall and short tussock grassland and shrubland (*Dracophyllum, Discaria, Coprosma*) was already established in the high country. As they explored during 1850s, the Europeans brought sheep and some cattle onto burnt ground. In the 1860s they added deer, goats and rabbits. Grazing pressure soon exceeded whatever effect birds, rats and invertebrates might have had before them. Where tall tussocks were repeatedly burned and grazed they gave way to short tussocks and other plants. In drier areas, short tussocks were replaced by exotic grasses and weeds.

The early pastoralists burned the vegetation too frequently and grazed it too heavily. Impacts were severe. Some effects still remain, but there have been many changes in the ways that the grasslands are managed.

"Dec. 25 (1851).....I was now a good height above the sea, but to my surprise the grasses in every sheltered nook were as fine and luxuriant as they are lower down." E.J. Lee describes his ascent of Barefell Pass (1407 m), (now in Molesworth Station) during a journey of exploration through the Awatere, Guide & Clarence rivers and over Jollies Pass to Hanmer basin, seeking land for a sheep run.

150 years ago





These and other grasses, which all came with the early European settlers, now grow naturally in the tussock grasslands. Introductions were either deliberate (for pasture or crop) or accidental, such as impurities in seed or in the fleeces of sheep.

Exploitation 1850–1880

Pastoralism begins

Investment of capital was in sheep, not in land purchase. There were no fences to control grazing. Exports of wool, wheat and gold drove the economy.

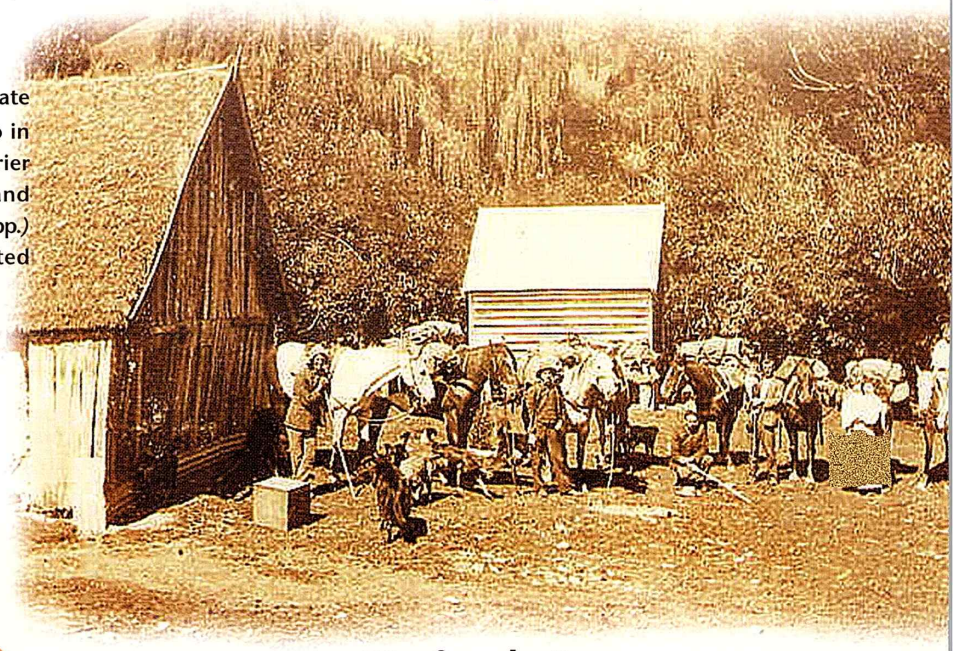
Sheep numbers in South Island

(excluding the West Coast)

1861	2.1 million	
1871	7.8	"
1881	8.9	"
1891	10.3	"
1901	10.0	"

Sheep numbers increased at a fantastic rate; over 200% from 1861 – 71. By 1890 numbers on unimproved grasslands were declining, and continued to drop for 70 years in most areas.

Grassland depletion to a state of desert was reported before 1900 in North Otago, Central Otago, and drier parts of the Mackenzie Basin and Marlborough. Scabweeds (*Raoulia* spp.) became widespread on depleted ground in drier areas.



1860s & early 1870s

The only source of feed for the rapidly increasing numbers of stock was native grasslands and some introduced grasses that had arrived accidentally and became established. Wool prices were erratic and financial crashes frequent.

The earliest pastoralists

were often squatters grazing sheep without purchasing land. Leases were applied for as empty land was found and boundaries described.

Government authorities

were keen to get land occupied and stocked. Lessees were required to stock land with a minimum number of sheep (or sometimes cattle) to validate their lease.

Ecological Ignorance

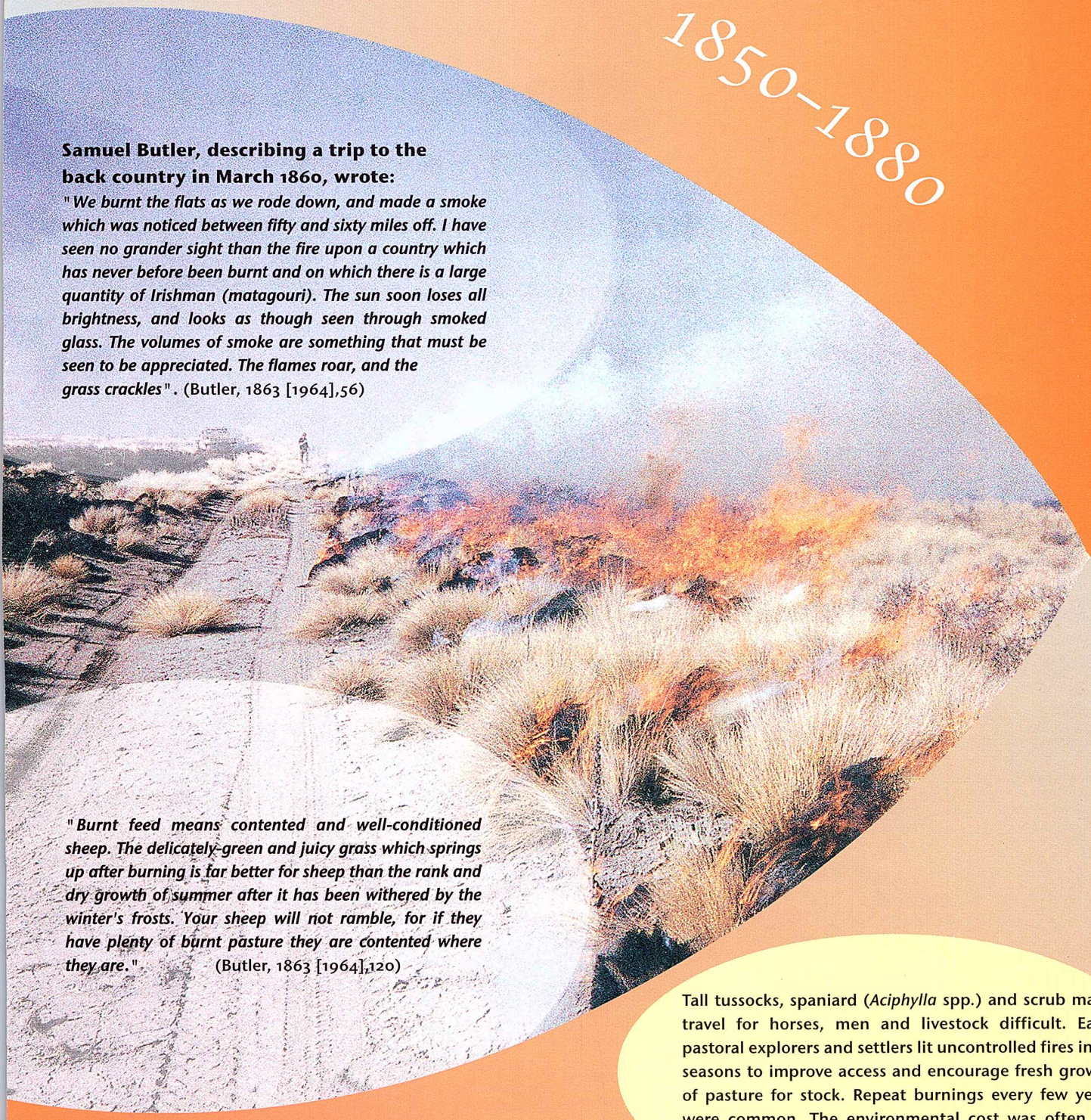
Browsing and trampling mammals, game animals, predators and plants were introduced – both accidentally and deliberately. As early as the 1860s naturalists expressed concern about burning and grazing and the subsequent loss of finer grasses.

Rabbits

By 1880 rabbit numbers reached plague proportions across the high country, where vegetation already depleted by sheep provided an ideal habitat. Rabbits remained out of control for 20 years, even in areas no longer considered rabbit prone, such as those with higher rainfall.

1850–1880

Samuel Butler, describing a trip to the back country in March 1860, wrote:
"We burnt the flats as we rode down, and made a smoke which was noticed between fifty and sixty miles off. I have seen no grander sight than the fire upon a country which has never before been burnt and on which there is a large quantity of Irishman (matagouri). The sun soon loses all brightness, and looks as though seen through smoked glass. The volumes of smoke are something that must be seen to be appreciated. The flames roar, and the grass crackles". (Butler, 1863 [1964],56)



"Burnt feed means contented and well-conditioned sheep. The delicately-green and juicy grass which springs up after burning is far better for sheep than the rank and dry growth of summer after it has been withered by the winter's frosts. Your sheep will not ramble, for if they have plenty of burnt pasture they are contented where they are." (Butler, 1863 [1964],120)

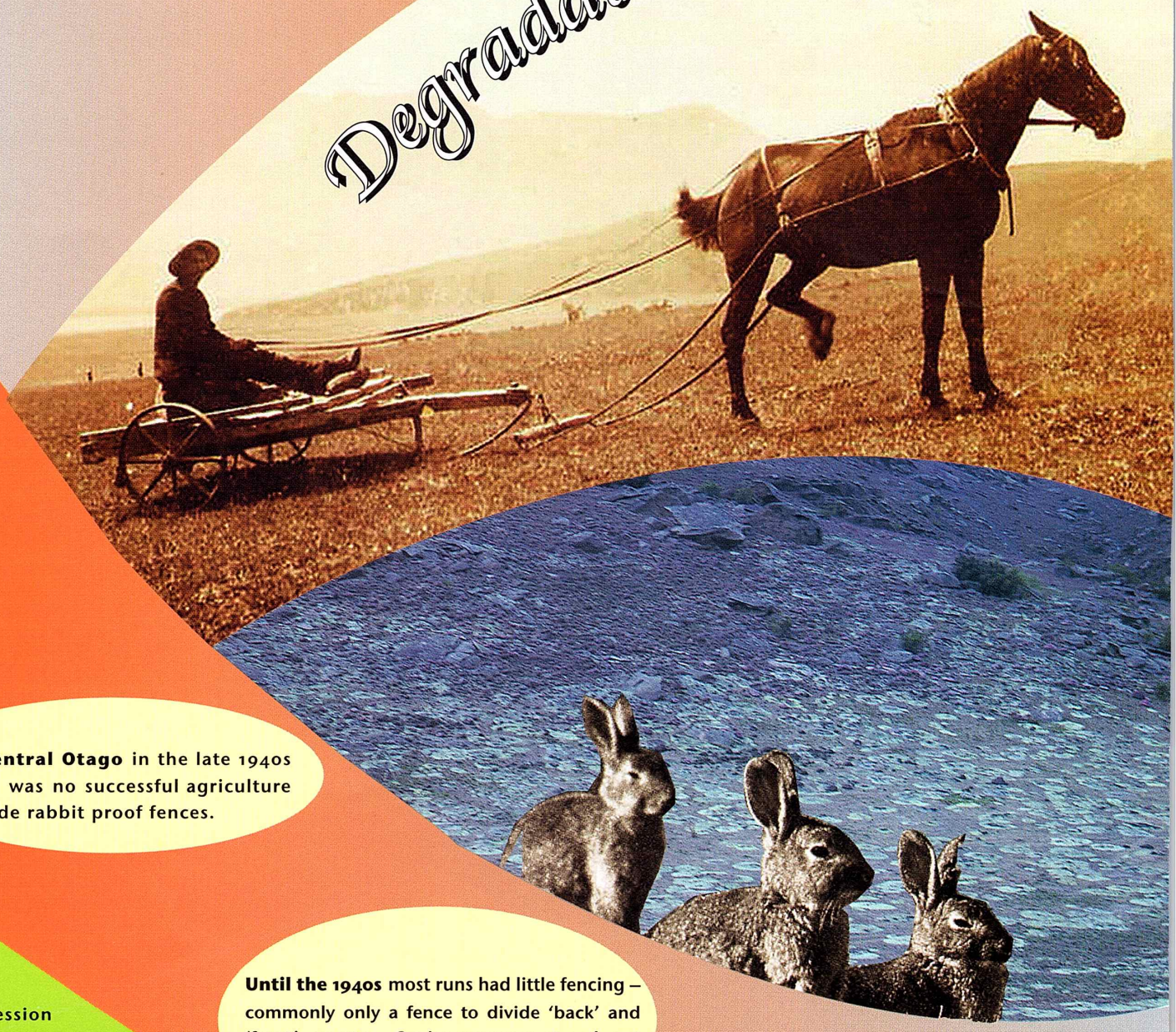
Tall tussocks, spaniard (*Aciphylla* spp.) and scrub made travel for horses, men and livestock difficult. Early pastoral explorers and settlers lit uncontrolled fires in all seasons to improve access and encourage fresh growth of pasture for stock. Repeat burnings every few years were common. The environmental cost was often far higher than they foresaw.

The tall tussocks were found to have little feeding value for stock, except for young growth following a fire. Burning opened up the tussock and shrublands and allowed other finer grasses, short tussocks and herbs to flourish, at least initially. With no fences to control stock, it was not possible to manage grazing after a fire. Sheep preferred finer grasses that appeared as the vegetation recovered from burning and selected these, while coarser, less palatable grasses and other plants remained and dominated.

Degradation 1880–1950

Pastoral degradation set in about 20 years after initial stocking and continued for 70 years. As sheep continued to eat, tall tussock grassland became short tussock and then opened out to weeds, scab weed and desert.

Rabbits were widespread and remained out of control in the drier areas e.g. Cental Otago. By hunting, poisoning & other means, large areas in wetter environments were kept reasonably clear of rabbits.



In Central Otago in the late 1940s there was no successful agriculture outside rabbit proof fences.

Until the 1940s most runs had little fencing – commonly only a fence to divide 'back' and 'front' country. Grazing management and pest control options were very limited.

A succession of Commissions made recommendations to Government for management of pastoral runs.

1910	Canterbury Pastoral Runs Classification
1920	Commission on Southern Pastoral Lands
1940	Sheep – Farming Industry Commission report
1945	Royal Commission to inquire & report on the sheep farming industry

The outcomes inevitably resulted in Government retaining ownership of most of the land with the view that this was best for the land.

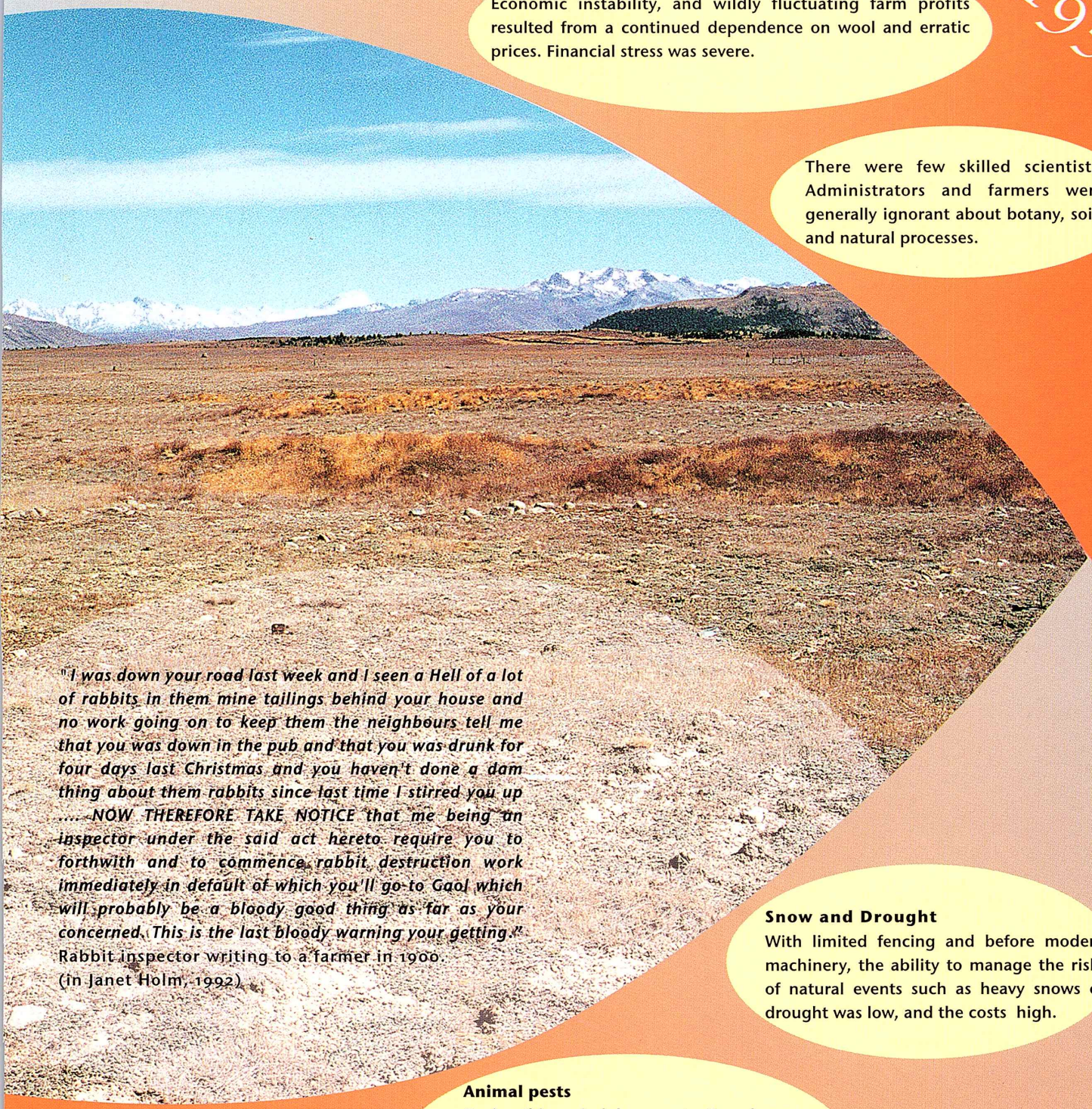
Weeds – Prickly, rough and unpalatable plants invaded the degraded grasslands. In the 1940s large areas of weeds – especially sheep's sorrel – were common on land devastated by sheep and rabbits. Conditions have never deteriorated to the same level since.

1880–1950

Stock numbers in the high country reached their peak around 1880, then declined and continued to drop until the 1950s.

Economic instability, and wildly fluctuating farm profits resulted from a continued dependence on wool and erratic prices. Financial stress was severe.

There were few skilled scientists. Administrators and farmers were generally ignorant about botany, soils and natural processes.



"I was down your road last week and I seen a Hell of a lot of rabbits in them mine tailings behind your house and no work going on to keep them the neighbours tell me that you was down in the pub and that you was drunk for four days last Christmas and you haven't done a dam thing about them rabbits since last time I stirred you up .... NOW THEREFORE TAKE NOTICE that me being an inspector under the said act hereto require you to forthwith and to commence rabbit destruction work immediately in default of which you'll go to Gaol which will probably be a bloody good thing as far as your concerned. This is the last bloody warning your getting."
Rabbit inspector writing to a farmer in 1900.
(in Janet Holm, 1992)

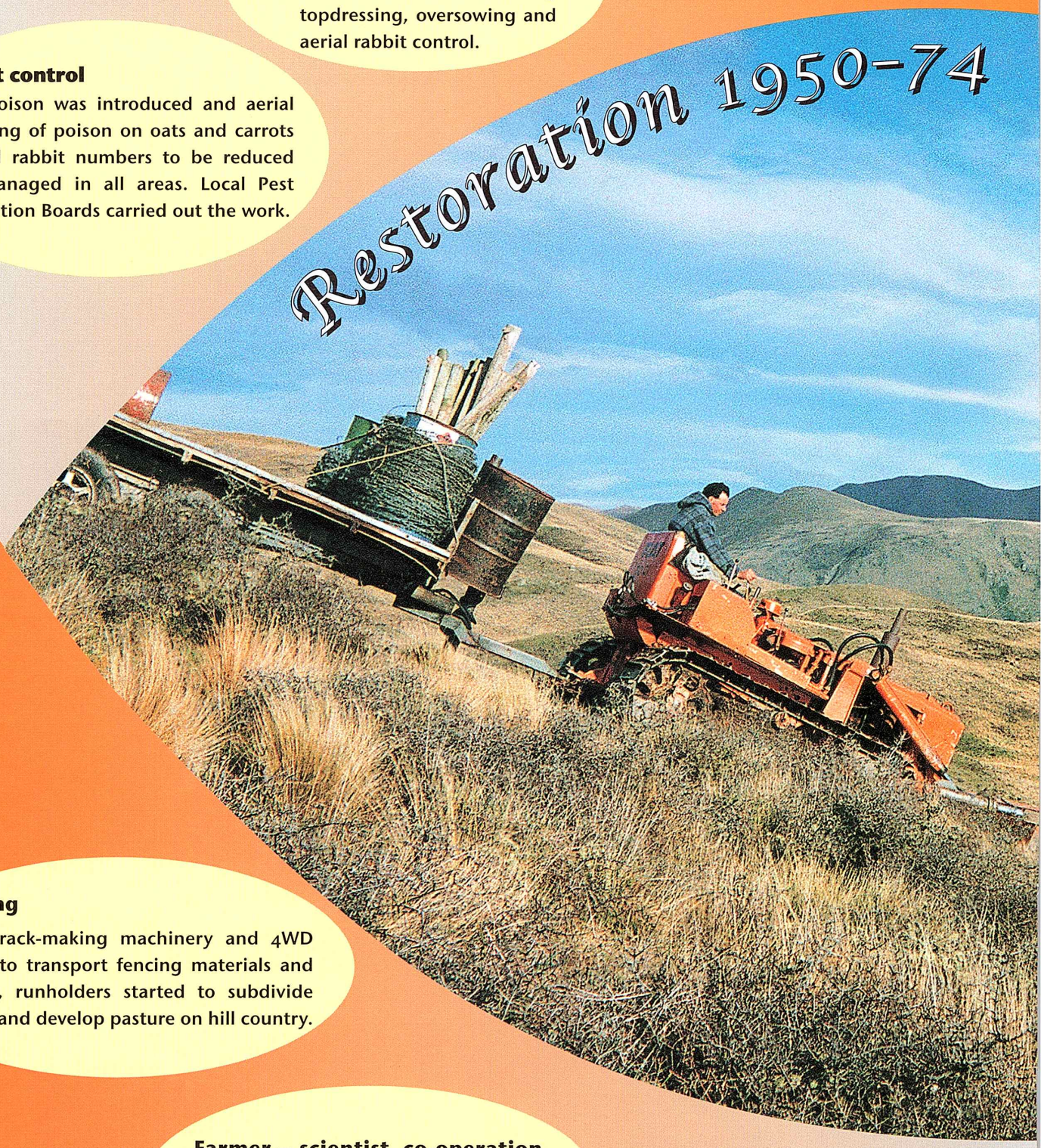
Snow and Drought
With limited fencing and before modern machinery, the ability to manage the risks of natural events such as heavy snows or drought was low, and the costs high.

Animal pests
During this period deer, goats, Canada geese, pigs and thar all became increasing problems in some parts of pastoral high country, destroying vegetation, and soil resources and being a direct cost to farming.

As pastoral production declined with depletion of the grasslands, successive Governments tried to correct the problems, without understanding the ecological and other reasons for the land degradation.

1948 Land Act introduced 33 year leases which could be renewed in perpetuity. Before this runholders had short term leases with no permanent right of renewal, which made them reluctant to invest in the land. The new leases made it possible to borrow finance for development.

Restoration 1950–74



Commercial aviation
provided practical solutions for land restoration enabling topdressing, oversowing and aerial rabbit control.

Rabbit control
1080 poison was introduced and aerial spreading of poison on oats and carrots allowed rabbit numbers to be reduced and managed in all areas. Local Pest Destruction Boards carried out the work.

Fencing
With track-making machinery and 4WD trucks to transport fencing materials and people, runholders started to subdivide blocks and develop pasture on hill country.

Farmer – scientist co-operation, and the development of field-based research provided new understandings and management options.

Economic pasture development became possible using clovers and fertilisers. By 1970s most livestock feeding was from improved pastures. Maintenance of these clovery pastures depended on adequate moisture and financial returns to keep applying fertiliser.

Topdressing
with superphosphate and oversowing with clovers and pasture grasses became recognised as essential to maintain livestock production and vegetation cover for soil protection.

1950–1974

Investment
Incomes in the 1950s were satisfactory and development plans went ahead. The attitude for investment in the land changed as farmers reflected the security offered by the Land Act, with permanently renewable leases.

Land development became affordable as comprehensive rabbit control enabled livestock performance to improve dramatically. Smaller blocks gave better control of grazing.

Names of plants
Researchers, farmers and Government field officers learned the names of tussocks and other plants. Together with soil conservators they began land use planning for the tussock grasslands.

Fertiliser use rose through 1960s & early 1970s. High country farming, like mainstream pastoral farming, became dependent on fertiliser to maintain production. As fertiliser use increased, hieracium spread was reduced but matagouri increased.

Land Act 1948

* Provided a sense of ownership with permanent right of renewal for leaseholders.
* Stock limitations were set for each property.
* Consents were required for non-pastoral uses – cultivation, forestry, tourism, burning etc.
* Lending agencies began to treat those with pastoral leases the same as freehold borrowers.

Forces for change 1975–2000

1970s

In the high country, as elsewhere in NZ, tax payer inputs supported land development, rabbit and weed control, and provided minimum stock prices.

1980s

Sudden government policy changes eliminated incentive schemes and other subsidies. Risks surrounding pests, weeds and product prices now became the farmer's business – not the government's.

Rabbits were again out of control in many areas by 1985. An intensive Rabbit and Land Management Programme (1989–95) provided some respite for the worst affected areas, but no affordable long term solutions. Existing controls were proving to be inadequate.

RHD (was RCD[1])

The decision to refuse the introduction of RHD was seen by many as illogical. It noted there was uncertainty over RHD's likely effectiveness, but that risks to humans and other species; of mutation; or predator-prey switching were not reasons for declining the importation. Its arrival, accidentally or illegally, was predictable and inevitable.

[1] Rabbit Calicidisease virus

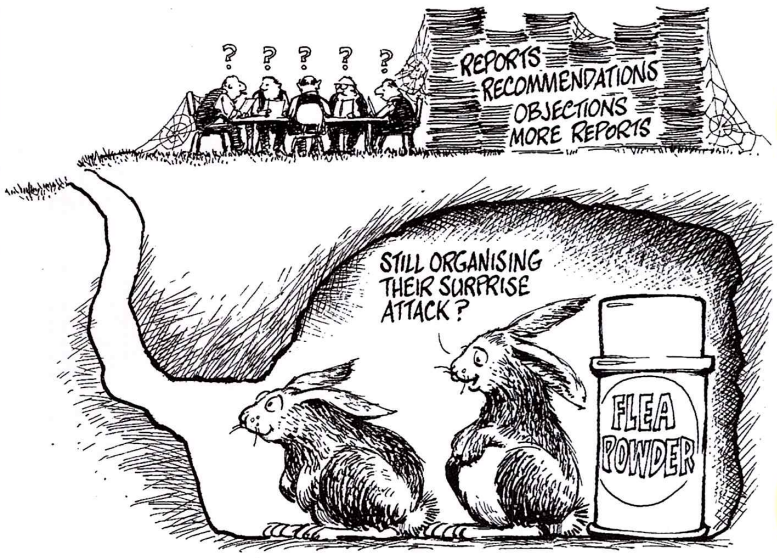
Vegetation recovers

Despite the biosecurity breach, RHD has proven to be an outstanding control in most areas, at least in the short term. There has been excellent recovery of vegetation cover and linked with this beneficial effects on native moths and other invertebrates. Rabbits remain a pervasive pest but land managers continue to control rabbits that may be RHD resistant and to keep numbers low.

Resource Management Act 1991

"Sustainable management" is the goal. Farmers support the objectives, although implementation proves to be a frustrating process.

On many properties improved pasture, pest and stock management have produced more resilient systems, reducing the uncertainties from seasonal and market fluctuations.



Many pests are controlled to manageable levels. Management plans for thar and Canada geese have been developed with government, hunters and farmers around the table. Agreements reached have enabled population levels to be managed, sport hunting to be provided, and legislative requirements met.

Weeds

Hieracium becomes a widespread problem in many areas, particularly on poorer soils and drier aspects. In the 1990s a rust and an insect are released to provide some biological control. Research reveals a complex problem with few clear answers for reducing the spread.

Fire is used strategically, usually to prevent improved grasslands reverting back to woody species such as manuka and matagouri. Regulations ensure that the areas burnt and the timing and the frequency of fires are well controlled. The need for planned post burn management, including seed, fertiliser, and grazing control is recognised as critical for land recovery.

Reports to government begin to make linkages between ecological aspects and financial, community and policy issues.

1982	"Crown pastoral leases & leases in perpetuity" Report of the Clayton committee
1987	Parliamentary Commisioner for the Environment recommends a Task Force to examine the whole issue of sustainable land management & rabbits
1988	Rabbit Land Management Task Force reports to the Minister of Agriculture
1991	Parliamentary Commissioner for the Environment: "Sustainable land use for the dry tussock grasslands in the South Island"
1994	"South Island High Country Review: Report to Ministers of Agriculture, Conservation & Environment"
1995	Parliamentary Commissioner for the Environment: "A review of the government system for managing the South Island tussock grasslands – with particular reference to burning"

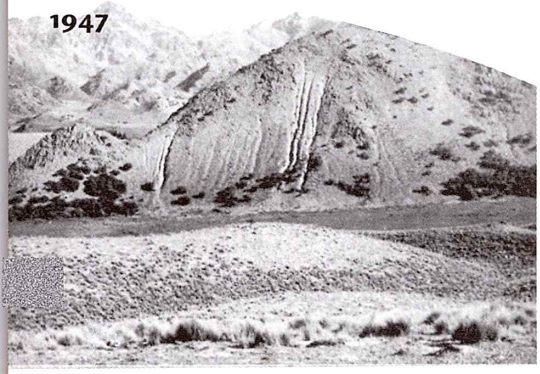
Crown Pastoral Land Act 1998

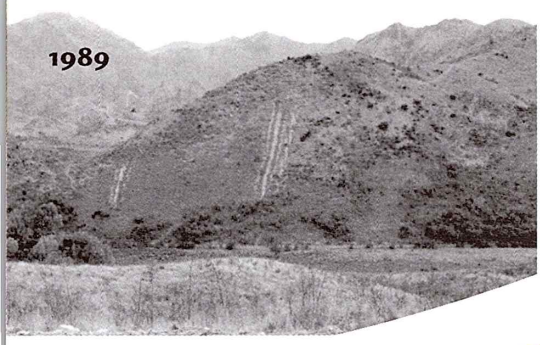
superseded the 1948 Land Act.

* Consents are still required for cultivation, oversowing, burning etc.
* It makes freeholding possible for some land and returns other land to full Crown ownership and management, generally for conservation.

Changes over time

Gooseberry Gully, upper Awatere Valley shows an increase in vegetation cover over 45 years. (OCL, 1993)



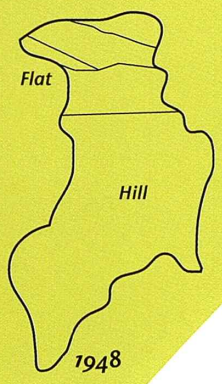


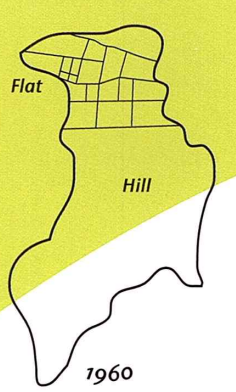
The combination of sheep grazing, high rabbit numbers and persistent burning during the first 50 years of high country farming led to rapid deterioration of vegetation cover. The exposed soils here were readily eroded by frost, wind and rain. From the 1950s improved rabbit control, fertiliser and oversowing with grasses and clovers began to restore the cover. Now, there is better understanding of the suitability of different land types for particular uses, as well as the limitations and risks involved.

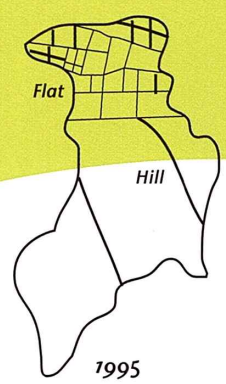
Not all erosion is caused by people. Many shingle screes and landslips occur naturally as a feature of New Zealand's relatively young landscape.

Hieracium is a major weed of the tussock grasslands. Severe invasion occurs not only in grazed areas but also where land has been ungrazed for many years. Research to date gives little optimism that grazing management can prevent hieracium from spreading, although it may be slowed by grazing the flowers. Recently released biological controls, such as insects, may be able to affect plants sufficiently to slow the spread and reduce their vigour.

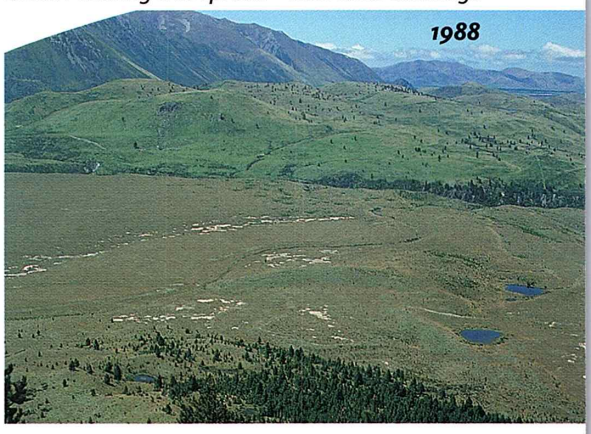
Typical stages in subdivision of a high country property. Subdivision and fencing dramatically change the way stock and land can be managed, by enabling grazing to better match feed availability.

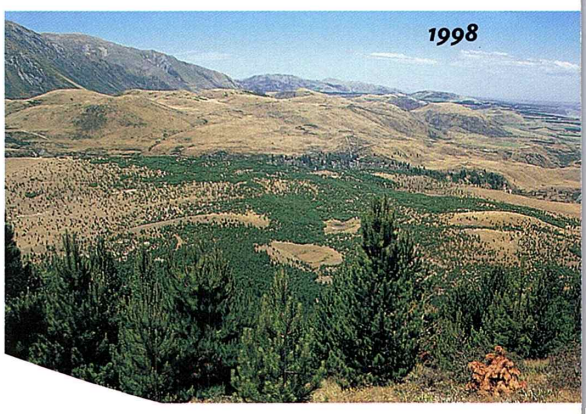






Below: Wilding tree spread – near Lake Coleridge





Most of the tussock landscapes are a natural environment for woody species. In the past these have been kept in check, particularly by burning.

The spread of wilding conifers is becoming increasingly apparent, and raises important issues for nature conservation, farming and landscape values. Wilding spread from new plantations can be managed through site and species selection and active pasture management of surrounding land. Dealing with existing wilding areas is much more problematic, as there are large areas of highly invasive species, and many seed sources.

As Professor Kevin O'Connor noted in 1981:

"The success of woody revegetation will force land managers to choose between evolving forests and maintaining improved pastures. Making that choice will be the principal landscape planning issue for the tussock grasslands and mountain lands for the next twenty years".

Canterbury 1990s

Developed/ clover *Native/Hieracium*

Central Otago 1992

With rabbit control. *Without rabbit control.*

Farm development: seed and fertiliser inputs, rabbit control and fencing all enable properties to minimise and manage risks to land, stock and farm business.

Pastoralism becomes pastoral farming:

A case study

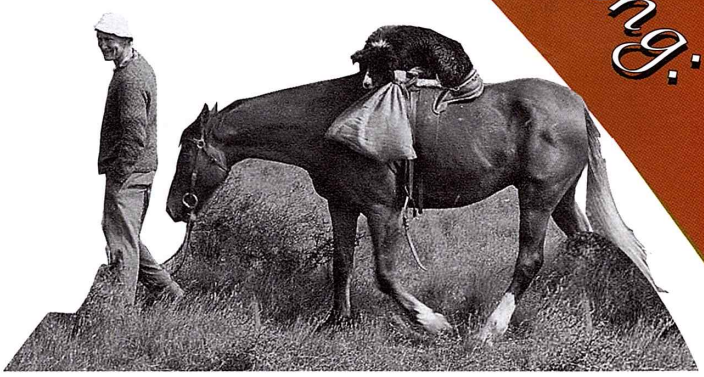
Unless we look closely at how high country farming has changed over time, it is all too easy to gaze at the landscape today and believe that very little has changed since the first pastoralists arrived in the 1850s and 60s.

As we look at the different eras of farming in the high country, it becomes apparent that the way these properties are managed now is vastly different from the past. It's not just technology that's changed, it's also about the animals themselves, when and where they graze, and what they feed on.

During the 19th century many high country runs became enormous (more than 50,000 ha), usually through the acquisition of several adjacent leases. By 1915 many of the large properties had been broken up again.

Initially the only fences were some boundary fences between neighbours. By 1900 runs had often been fenced into two, with the higher altitude country separated from the lower country, or the hill block from the flats. At the time this was seen as a huge advance as it controlled where stock grazed. There was little or no further subdivision fencing on most runs until the late 1940s. However, once the benefits of aerial topdressing were appreciated, and 4WD trucks enabled fencing materials to be moved more easily, both hill blocks and flats were divided into smaller blocks.

The details vary from property to property, but the overall picture is similar. Farm management has changed substantially, with stock grazing for most of the year on developed pastures, often supplemented by hay, silage or green feed crops in winter. However, summer grazing of undeveloped grasslands is still vital to most of these farm businesses.



The story of Double Hill Station in the Rakaia Gorge shows how farm management in the 21st century is still highly challenging for the current generation. As an example, the amount of high quality wool produced in recent years from 7,900 ha at Double Hill is greater than the amount produced in 1918 from five times the area.[1]

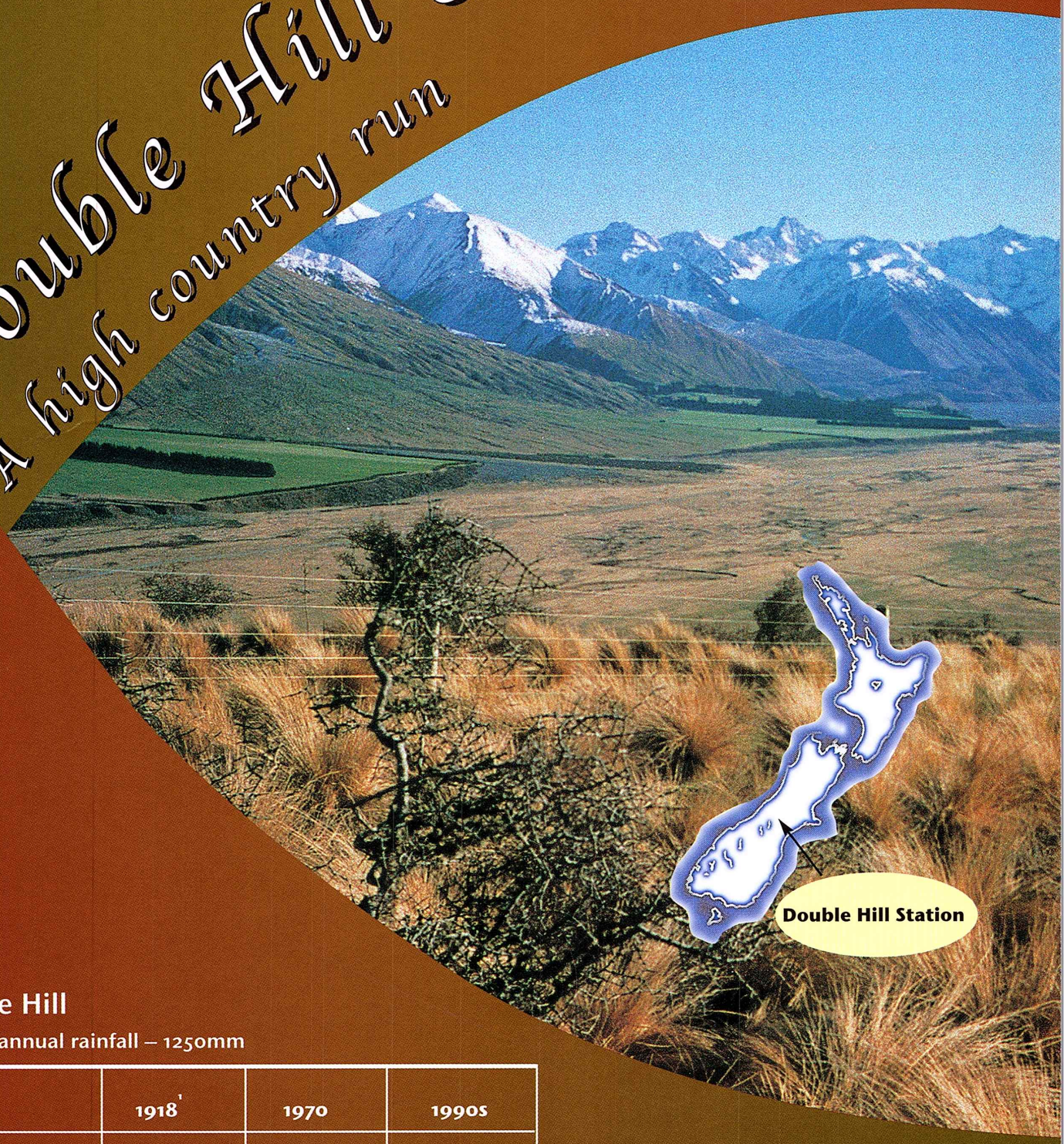
In 1918 all the grazing was from native grasslands. Now more than 90% of production comes from the developed pastures on lower altitude land. The higher, undeveloped country is only grazed for about 6 weeks in February/March by limited numbers of adult stock.

Evidence from Double Hill and many other high country properties suggests that the productive capacity of the high country is not continuously declining. However, the sparse measurements taken across the high country over the years make it hard to quantify changes. New monitoring programmes supported by landcare groups are providing farm families with the techniques to collect their own data and verify what is happening.

Note:[1] At this time Double Hill and 2 neighbouring properties were run as one 40,000 ha business.

Double Hill Station

A high country run



Double Hill

Average annual rainfall – 1250mm

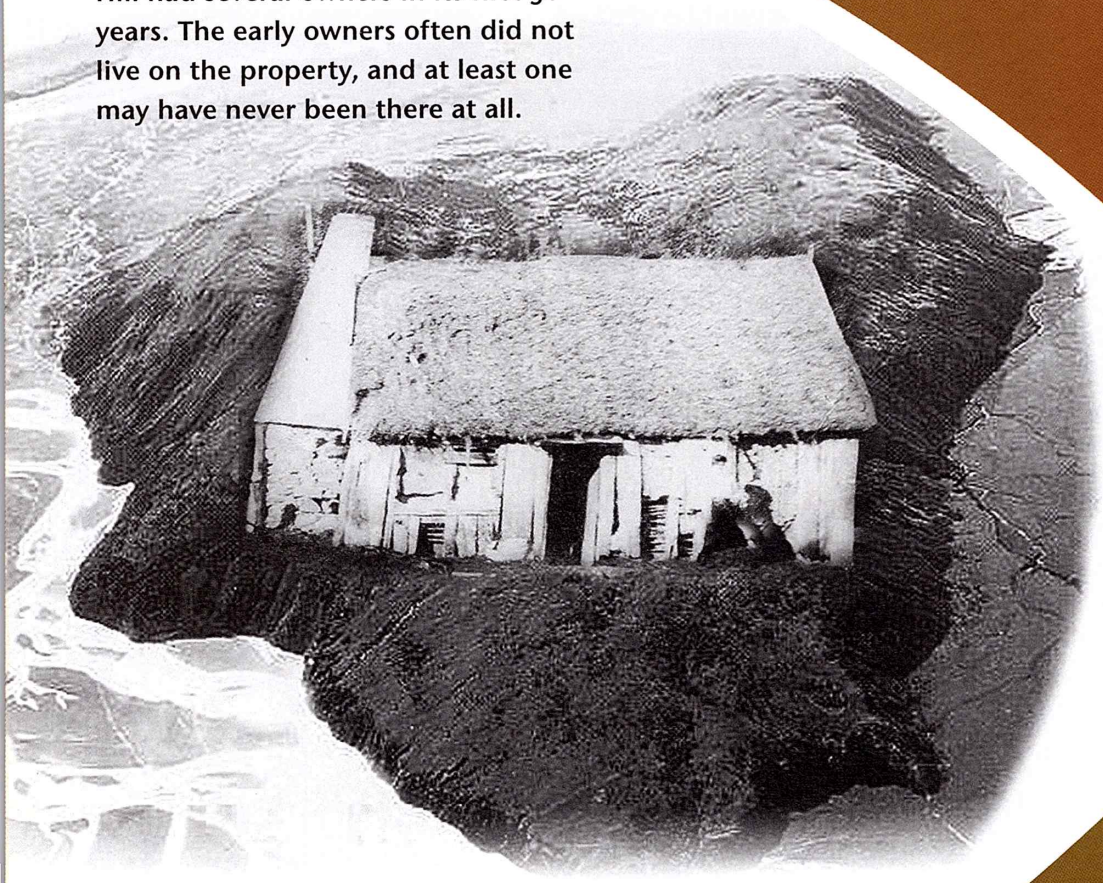
	1918[1]	1970	1990s
Area (ha)	40,000	15,000	7,900
No. of sheep	17,000	5,600	11,500
Wool shorn (kg)	41,000	26,000	55,000
Wool/sheep (kg)	2.4	4.6	4.8

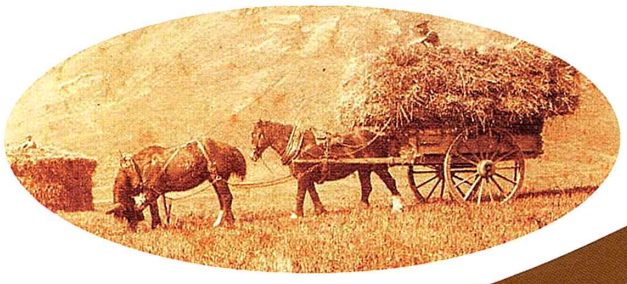
Seeking a Sustainable Stocking Rate

"The art of successful high country farm management is to operate close to the threshold stocking rate without overstepping it. The threshold stocking rate is that which – if exceeded – results in depressed animal performance and depletion of the pasture base." (Allan, 1997)

Double Hill 1850–1900

Few details are available of the early days but, typical of many runs, Double Hill had several owners in its first 50 years. The early owners often did not live on the property, and at least one may have never been there at all.





1858
Colonel Alexander Lean took up the first grazing licences for land now in Double Hill Station.

1863–68
Joseph Palmer, a banker, acquired 10 adjacent licences for land at Double Hill.

1874
Palmer sold Double Hill for 20,000 pounds. It was about 46,000 ha with 30,000 sheep.

1890s
The run was divided into two blocks, which improved stock management.

The 'snow fence' built about 1890 stretched over 25 kms across the property, dividing 'winter' and 'summer' country. About 20 packhorse loads would have been needed to transport the materials for each kilometre of fence.

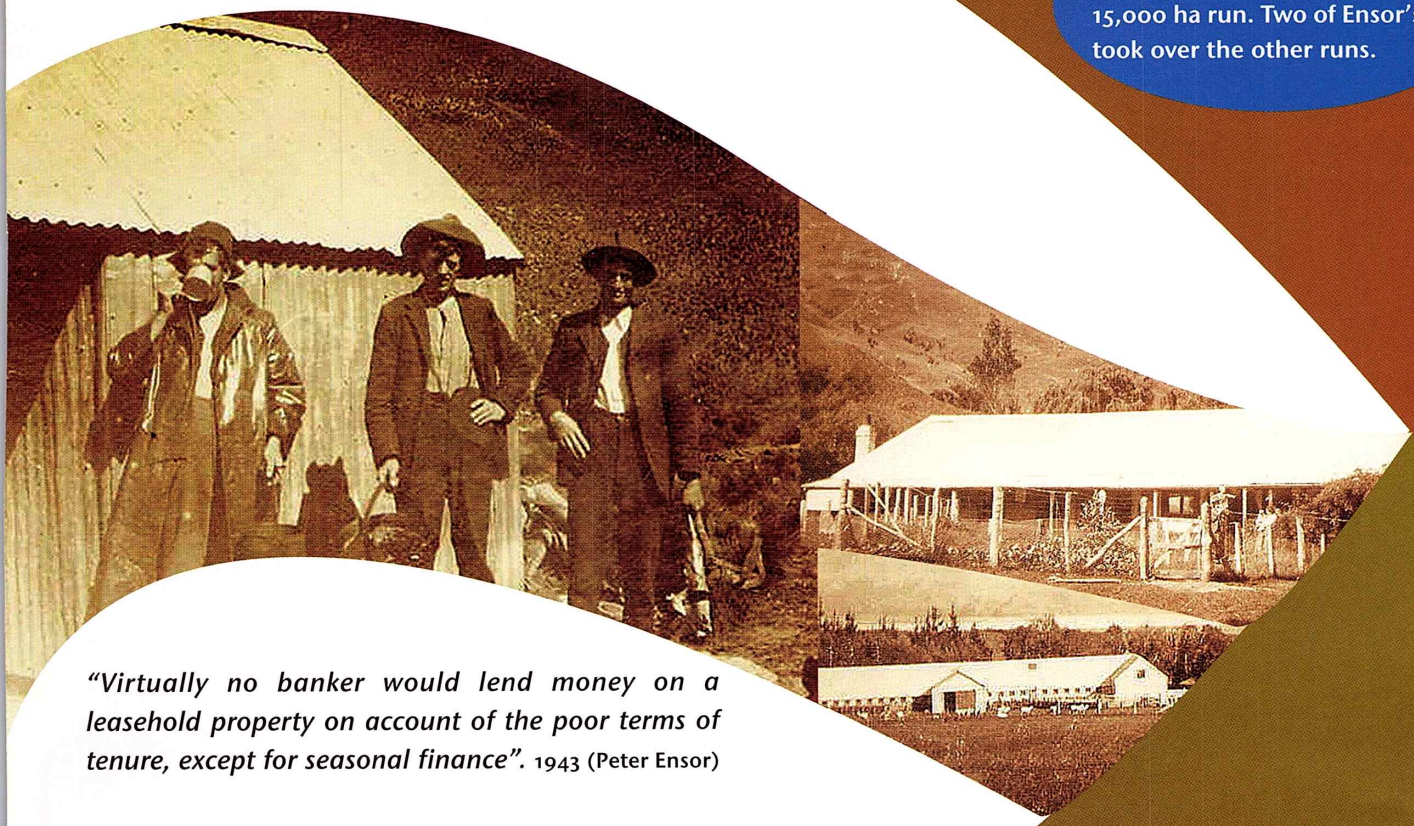
1900–1949

1948
Peter Ensor agreed to no back country grazing from mid-May to December.

1946
Subdivision of the blocks on Double Hill flats began.

1938
Double Hill was back as a separate 15,000 ha run. Two of Ensor's sons took over the other runs.

Hugh Ensor bought Double Hill in 1916. *"He was a quiet man who never raised his voice in anger...but he had a quiet determination & generally got his own way in most things"*. When he died in 1943 his son Peter took over management of the property.



"Virtually no banker would lend money on a leasehold property on account of the poor terms of tenure, except for seasonal finance". 1943 (Peter Ensor)

Before the road was built access to Double Hill involved crossing the Rakaia River. For carting supplies eight horses were hitched in pairs, with the idea that at least some of them would be on good footing if the crossing was difficult.

1930
Hugh Ensor & his family moved to Double Hill & took over day to day management. There were 11 permanent staff including 3 rabbiters, plus shearers & musterers when needed.

1925
The road to Double Hill was finished, & motor vehicles arrived. Washouts were common, & the last 40 km took over 2 hours.

1916–18
Ensor family purchased Double Hill & 2 of the neighbouring properties. Together there were 40,000 ha.

1913
Double Hill was split into 4 properties, each about 11,000 ha.

The big plantation of pines and other trees planted (in 1937) was the only planting done for many years as rabbits, hares and deer destroyed trees away from the homestead.

"Rabbits were a big bug-bear of those years and for many years to come...a terrible amount of time was spent rabbiting". 1920s (Peter Ensor)

Double Hill 1950-74

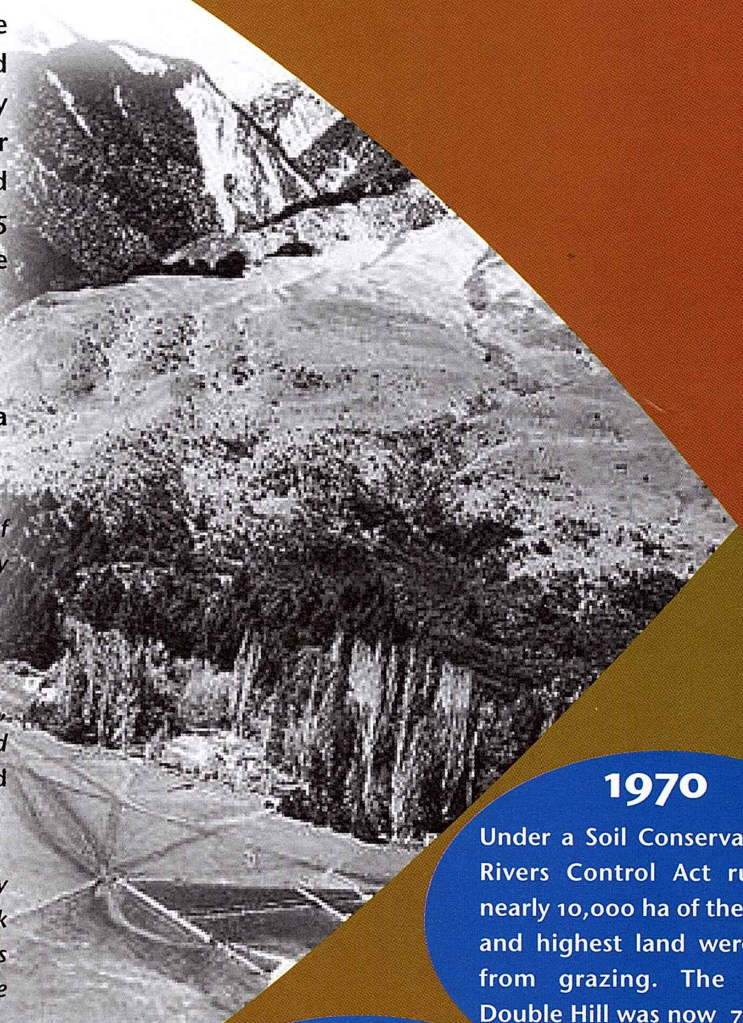
With the Land Act bringing a new sense of ownership at Double Hill, Peter Ensor recorded steady development work on the property in 1950s and 1960s. Fences, stock water systems, sheds, yards, and pasture received attention. By 1968 there were 9 paddocks, 5 hill blocks, 2 blocks on the flat and the large back country block.

In 1957, 1,600 kg of materials for a musterers' hut were dropped in from a Piper Cub aircraft. Nothing was damaged!

"Cultivated and drilled in quite a big paddock of green feed oats...and moved hoggets there in early May" (to overcome feeding gap in Autumn) *"Same plan followed ever since..."* – 1950

"Canada geese were becoming a major problem, with large numbers feeding on young grass and turnips." An organised 'shoot' with 4 planes and 200 guns did little to reduce numbers. – 1953

"The lambing percentage again increased largely because of the better feed for the ewes; a paddock of lucerne seed was sown and another of grass around the homestead area which had little in the way of improvements for many years". – 1954
(Peter Ensor, 1990)



1970
Under a Soil Conservation and Rivers Control Act run plan, nearly 10,000 ha of the steepest and highest land were retired from grazing. The area of Double Hill was now 7,900 ha.

1966
As the pastoral lease came due for renewal negotiations with the Government agencies began. "Considerable time was taken up with this problem...for the next 3 years – some of the recommendations I could agree with, some I could not". (Peter Ensor)

1960
By 1960 more than 50% of the farm production was coming from the developed land.

1953
The first aerial topdressing at Double Hill. Tiger Moth planes spread 20 tonnes of superphosphate and clover seed.

Peter and Lou Ensor brought up 4 daughters at Double Hill. They got their first radio telephone in 1950, but still had 16 gates to open to get to the main road. In 1971 their son-in-law Ben Hutchinson and daughter Lib took over management of the property.

1975–2000

Fencing
65 kms of fences were built in the 1970s and '80s, some with the assistance of Government incentives.

Fertiliser
These days 230 tonnes of fertiliser are applied each year to maintain the developed pasture.

Pastoral farming
Over 90% of farm production is now from developed country. Undeveloped blocks are used only in late summer to spell other areas before winter.

Conservation values
Despite the development work, Double Hill retains many features of conservation interest. The proposed Ashburton District Plan listed 7 areas on Double Hill with significant natural values.

Double Hill – 2000

No. of blocks		Area (ha)
41	cultivated paddocks	250
52	blocks are oversown & topdressed	1800
8	blocks on undeveloped river flats	1150
1	undeveloped tussock/native block	4,700
	Total area	**7,900**

Winter Feed		
Silage	1200	tonnes
Choumolier & swedes	19	ha
Oats	12	ha

Stock	
Sheep	11,500
Cattle	650

Nature Conservation

To protect the natural values of the tussock grasslands we need to consider conservation of species, habitats, ecosystems and landscapes. Public and private land owners and managers all have a role. Doing nothing is not an option. Some areas should be set aside as benchmark sites and managed without intervention so that the effects of natural processes (climate, ecological succession etc.) can be observed. Other sites, with various uses, should also be monitored for comparison with the representative benchmark sites. Together they would provide valuable information.

Elsewhere we need to retain some of these landscapes that reflect our natural and cultural history. It will require pest, weed and wilding tree management, grazing and/or fire to maintain grassland dominated ecosystems.

Conservation is one form of land use and, like others, it is not necessarily exclusive. It can often be provided on lands that are grazed, growing trees or being used for tourism and recreation. The Department of Conservation allows concessionaires to cater for additional uses on some Crown-owned conservation lands.

Facing page: Snowdon Station, Lake Coleridge – wetland covenant
Right: Ben Dhu Station, Omarama – scientific reserve
Below: Lake Ohau Station – upper Maitland tussock/alpine covenant

"Tolerance, patience and respect for rural culture will more effectively halt the decline in indigenous biodiversity by promoting a vision and engaging land managers to adopt a management style that enhances the values in their care. Enlightened management is achieved by leadership and example."
(John Kneebone, 2000)

Although many remnants of our natural or cultural history survived early pastoralism by chance, present runholders guard these features jealously and have learnt to appreciate their value.

In recent years confrontational experiences with the preparation of district plans under the Resource Management Act 1991 have been a significant setback to widespread integrated nature conservation on private and leasehold land. Runholders perceive covenants with management plans designed to protect specific values as better long term solutions than Crown ownership or rules in District Plans, especially for smaller areas surrounded by farmland or partly developed grasslands. Broad national or regional prescriptions are less likely to be successful than locally developed partnership approaches.

Many high country families have plans for formal protection of important conservation values. These cannot be put into effect until pastoral lease tenure review issues are resolved.

Towards Wise Stewardship

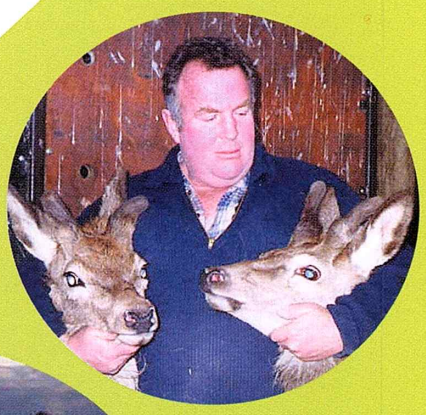
Management for conservation can be closely integrated with production. There are significant benefits to the wider community if landholders actively manage land for conservation. To improve conservation of tussock grassland habitats on private and leasehold land, there must be shared visions for the future that all can agree to. Issues that need to be addressed include:

* ecological reality
* economic reality
* the need for robust scientific knowledge as an input to management decisions

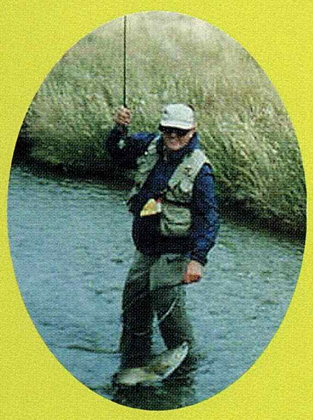
Local, regional and central government can readily support and encourage landholders by:

* acknowledging the importance of nature conservation on private land
* sharing responsibility with communities
* better resourcing management of public lands (Department of Conservation)
* providing more resources[1] for independent land conservation trusts such as QE II National Trust, and the landcare movement

[1] resources could include information and expertise as well as funding.



Private property rights should not, and need not, be compromised to achieve nature conservation objectives.



Covenants for nature conservation on private land

Covenants are legal agreements to protect privately owned land forever, and to manage it so that its special values are not at risk. They are generally registered on the land title to ensure that ownership changes do not threaten protection. QE II National Trust, Department of Conservation, Regional Councils and NZ Fish and Game Council can set up covenants.

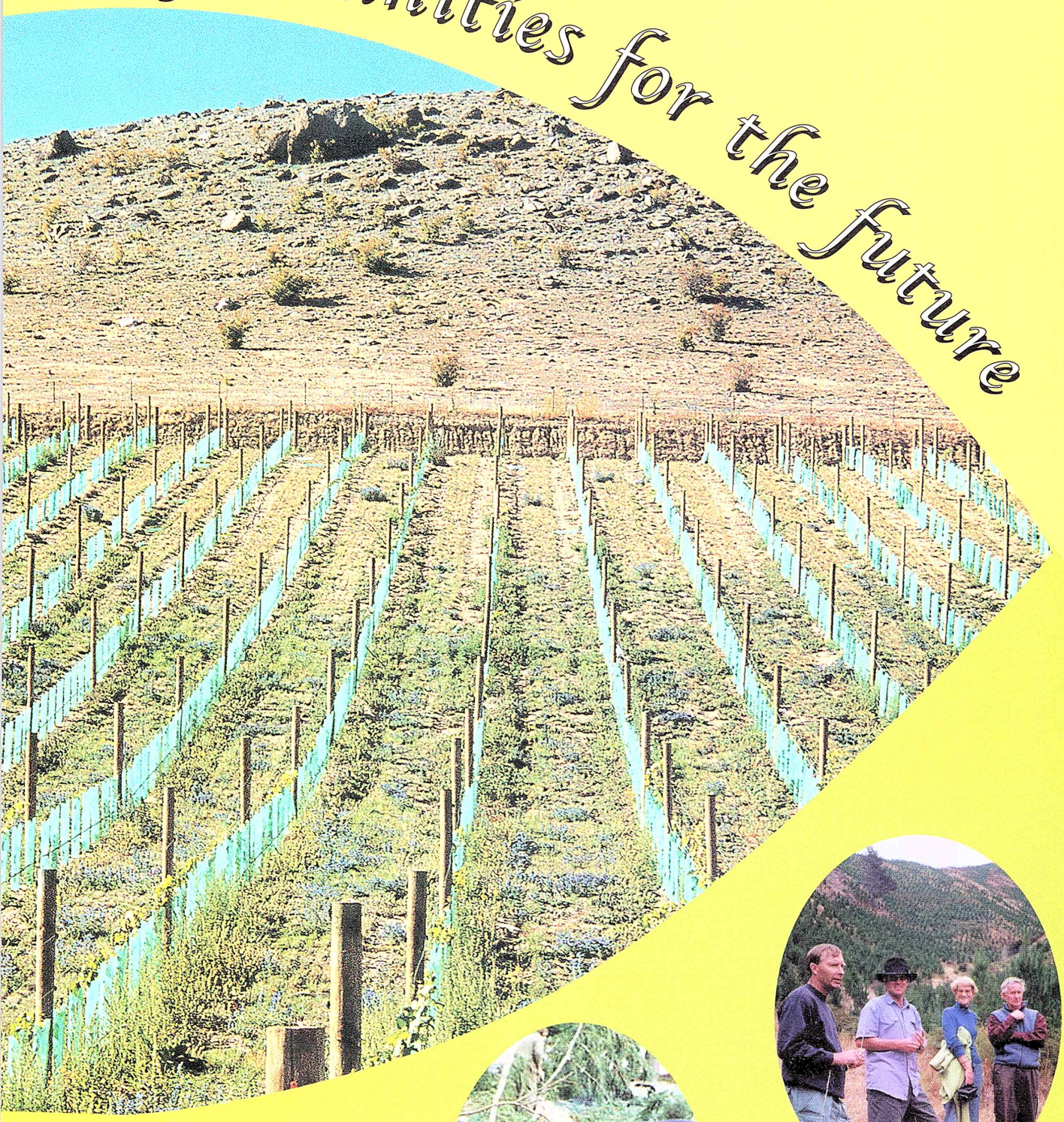
QE II National Trust Open Space Covenants

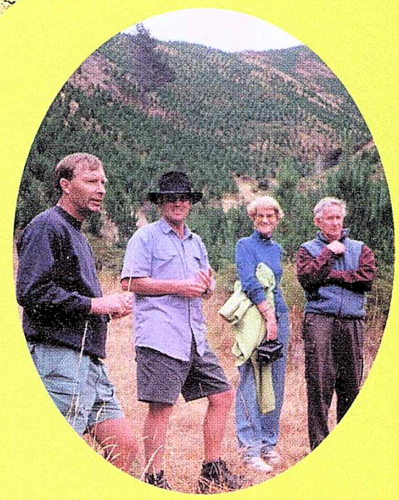
A National Trust covenant protects open space values on private or leasehold land. The values may be aesthetic, cultural, scenic, scientific or social and the area can be large or small. Covenants are set-up through the voluntary initiative of the landowner or lessee, but once a covenant is registered on a title it cannot be removed.

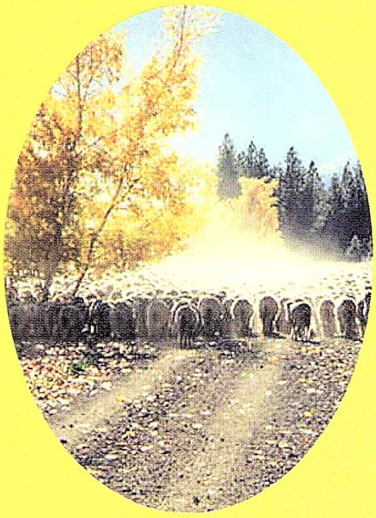
The National Trust is an independent organisation with government and private funding. It has a philosophy of conservation through knowledge and personal commitment. Individuals and families are helped to identify areas for protection and develop workable management plans that may include grazing if appropriate, or exclude it if inappropriate. Responsibility for ongoing management of the covenanted area remains with the landholder. There are currently 1,265 National Trust covenants throughout NZ, covering over 100,000 ha.

Given the right opportunities there will be many more covenants in the high country before long.

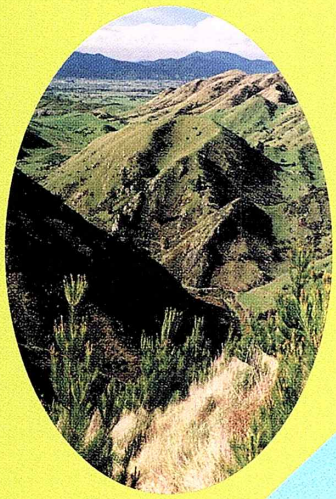
Opportunities for the future

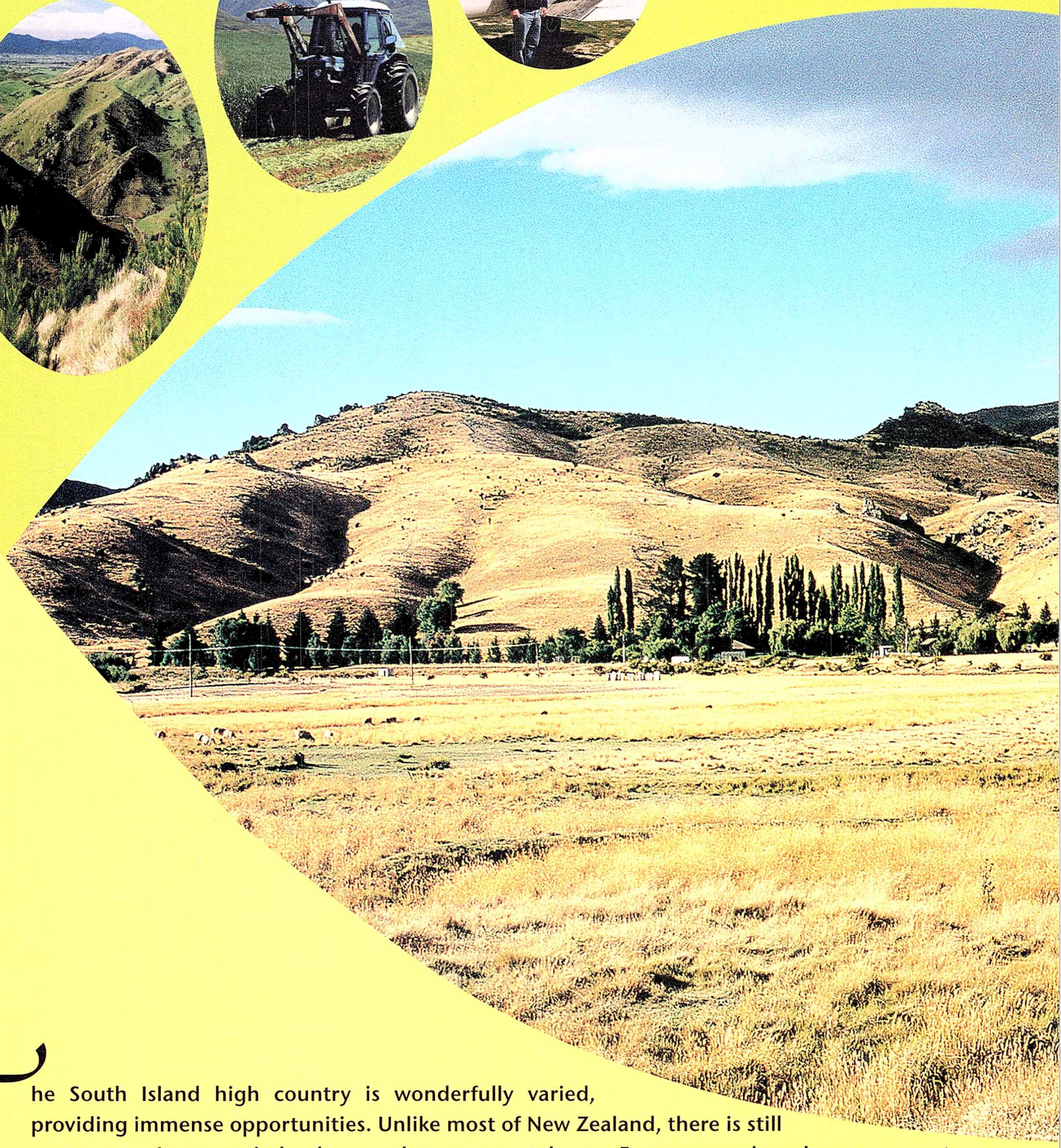






Quality products from a quality environment
A mix of farming, horticulture, forestry, nature conservation, recreation, tourism, public and private ownership.





The South Island high country is wonderfully varied, providing immense opportunities. Unlike most of New Zealand, there is still an opportunity to retain landscapes that represent the pre-European and pre-human ecosystems. Much land has already been developed and agriculture, horticulture and forestry will continue alongside increased nature conservation, recreation and tourism. Such a mix of uses is an option rarely available.

Private and public land ownership provides opportunities for different strategies to meet different needs. Conservation values are not confined to public land. Recreation on private land is widespread.

The future must be in partnerships – linking, sharing, growing; public and private ownership; farming together with tourism, recreation and conservation; urban with rural; commercial operators with community spirit; horticulture with tourism and many other combinations.

It is all possible, with wisdom and vision; the energy of youth and the experience of the young at heart; the rigour of science and the knowledge from true experience.
The future is in our hands. *Let's do it*!

Crown pastoral leases

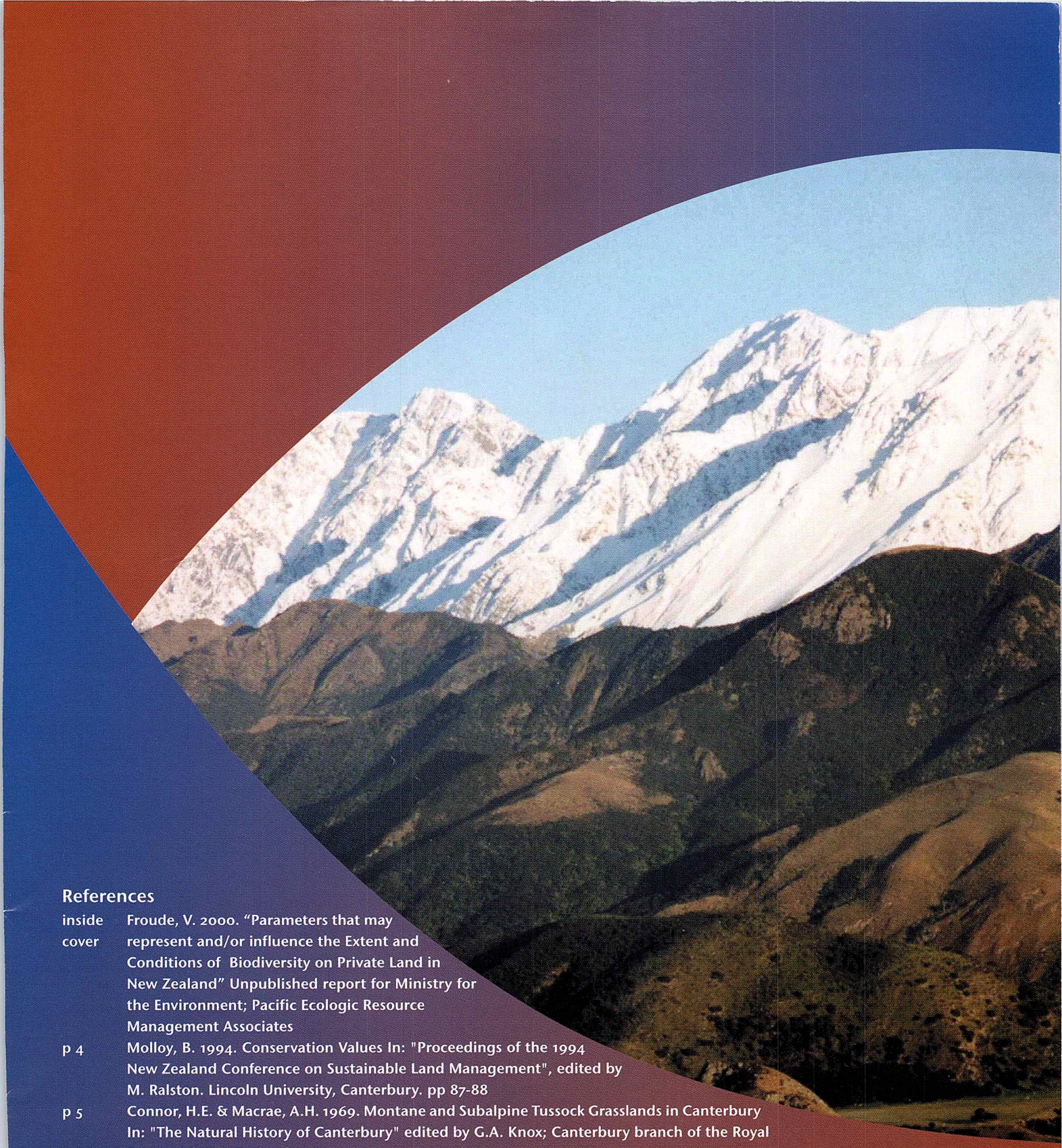
High country runs are a mixture of freehold and pastoral lease tenure in varying proportions. There are currently (2001) 304 pastoral leases covering 2.2 million ha.

Crown pastoral leases were set up by the 1948 Land Act, and provided for 33 year leases with a perpetual right of renewal. The objective was to provide lessees with the certainty of tenure to give them confidence to invest in improvements and long term sustainable management strategies. Lessees got rights to pasturage and to exclusive occupation (i.e. they are entitled to restrict public access to their land in exactly the same way as freehold owners). They have no rights to the soil or to use the land other than for pastoral farming without the permission of the Commissioner of Crown Lands. Lessees own all improvements, including buildings and pasture development. The Crown retained certain controls, such as requiring consents for activities other than pasturage including soil disturbance, vegetation clearance, burning, forestry and commercial recreation. The Crown retains an interest in the land, but is constrained by the perpetual rights of the lessees.

The Crown Pastoral Land Act 1998 retains the provisions for pastoral leases that were set in the 1948 Act but the new legislation also enables lessees to enter a process of tenure review. The objectives of the review are to

* return land with significant inherent values (such as having important ecological or historical attributes) or for public access and enjoyment purposes to full Crown ownership.
* freehold land capable of economic use and so remove the management constraints of pastoral leases.

The review process is set out in detail in the Act, and includes public consultation. The Department of Conservation has a major role in lease reviews as an advocate for public conservation and recreation objectives. When a review is concluded there is an exchange of rights between the Crown and the lessee. The Crown gets full ownership of some land and the lessee receives freehold of other portions. The total package may also include other agreements, such as public access arrangements, or protection of specific values on some freehold land using covenants.



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Acknowledgements

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Photo locations

Cover	Ashburton Gorge
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Page 3	Lake Heron
Page 4	Castle Hill Reserve
Page 5	Arrowsmith Station
Page 6	Mackenzie Basin
	Macaulay Hut
	Rakaia Gorge
Page 7	Clarence River
	Marlborough
Page 8	Bottom:
	Otamatapaio Station
Page 9	Bottom: Omarama
Page 10,11	Arrowsmith Station
Page 12	Lindis Pass
Page 13	Top: Mackenzie Basin
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Further reading

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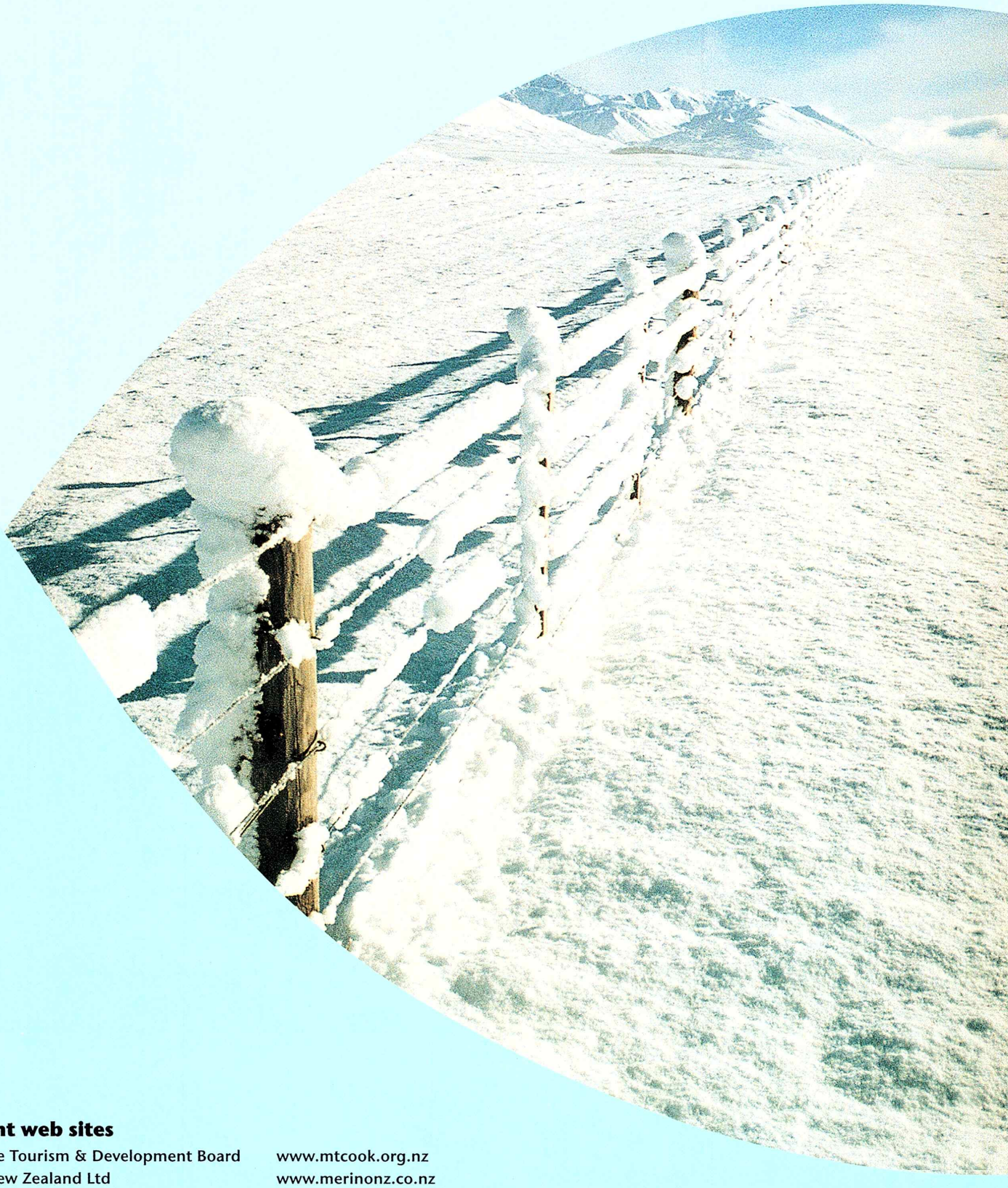

Relevant web sites

Mackenzie Tourism & Development Board	www.mtcook.org.nz
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NZ Stud Merino Breeders Society	www.merino.co.nz
Tussock grasslands research	www.tussocks.net.nz
Manaaki Whenua Press	www.landcare.cri.nz/information_services/mwpress
Central Otago	www.nzsouth.co.nz
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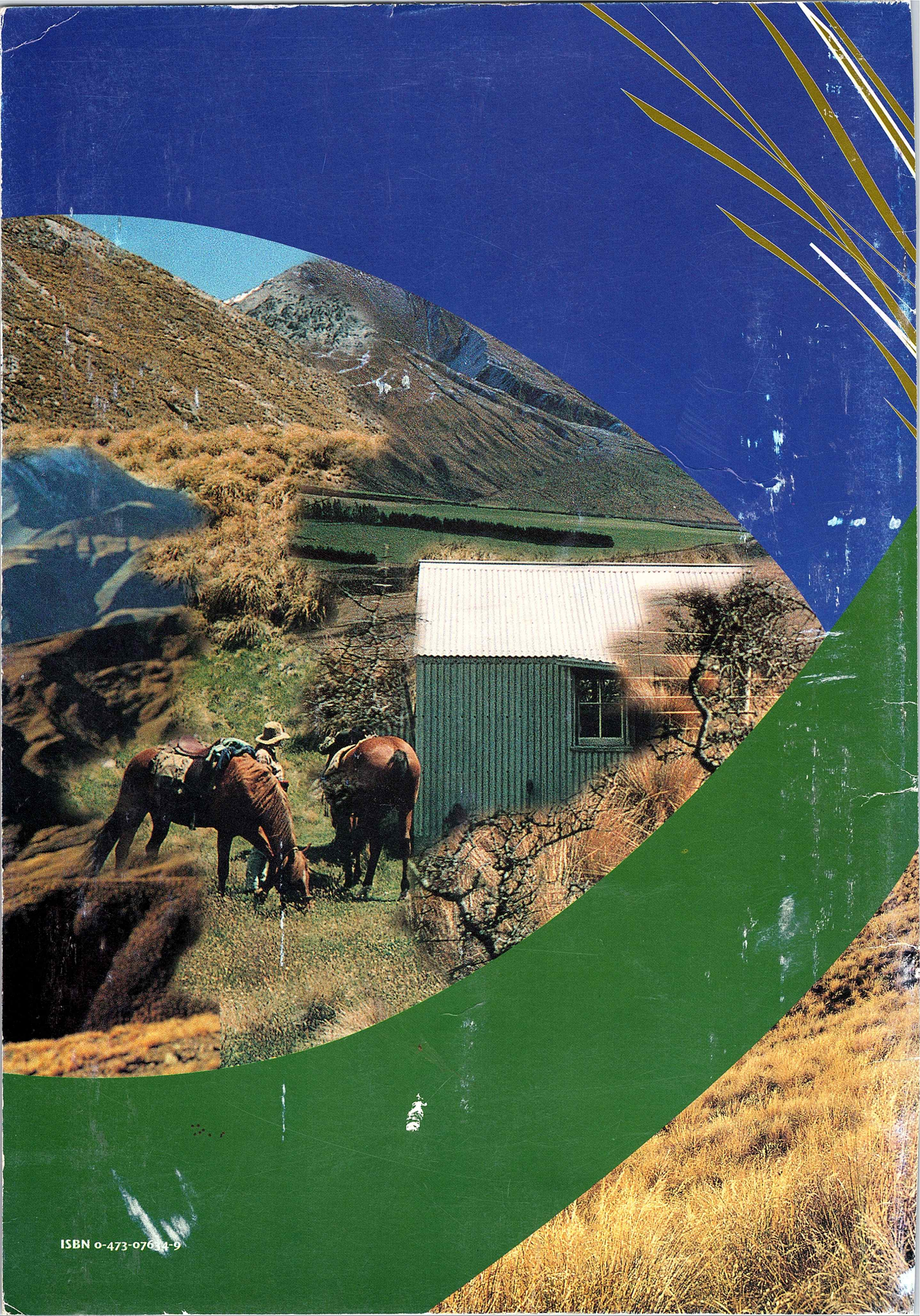
Otago Regional Council	www.orc.govt.nz
Environment Canterbury	www.ecan.govt.nz
NZ Landcare Trust	www.landcare.org.nz
Nelson Lakes National Park	webnz.com/nelson/doc/nelsonlakes.html
Federated Farmers	www.fedfarm.org.nz
Department of Conservation	www.doc.govt.nz



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